Fővárosi Rajzk. 1927

THE

REPERTORY

OF

ARTS AND MANUFACTURES:

CONSISTING OF

ORIGINAL COMMUNICATIONS,

SPECIFICATIONS OF PATENT INVENTIONS

AND

SELECTIONS OF USEFUL PRACTICAL PAPERS

FROM THE

TRANSACTIONS

OF THE

PHILOSOPHICAL SOCIETIES

OF ALL NATIONS, &c. &c.

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TWELTFH VOLUME.

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REPERTORY
OF
ARTS AND MANUFACTURES.

NUMBER LXVII.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

I. *Specification of the Patent granted to Mr.* JAMES WILLSON, *of the Pariſh of St. Anne, in the County of Middleſex; for his Invention of a Mode of preventing, in a material Degree, the Effects of Moiſture on the human Body, and of facilitating Relief in inflammatory and ſpaſmodic Complaints, ariſing from it and other Cauſes.*

WITH A PLATE.

Dated Oct. 22, 1795.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that in compliance with the ſaid proviſo, I the ſaid James Willſon do hereby declare, that my ſaid invention is deſcribed in the

drawings hereunto annexed, and the deſcription thereof hereunder written, and in manner following; that is to ſay: The manner in which the objects expreſſed in my patent are to be obtained, is, firſt, by a ſock or covering worn over the ſtocking, or next to the ſkin, made of the gut called by butchers the bung gut, of oxen, ſheep, or ſwine; or of the inteſtine of any animal; or of the exterior membrane called the peritoneum, of thoſe which afford one ſufficiently ſtrong; or of any ſkin or ſubſtance ſufficiently cloſe and ductile to be formed without a ſeam. They are firſt to be cleanſed by ſcraping and waſhing; and, when the inſide ſkins are to be preſerved for uſe, inflated until dry, and then the air is diſcharged; when required, they are to be immerſed in water until they become pliant. The membrane may be immediately uſed, without drying; and, when neceſſary to be preſerved, it is done by ſpreading on any ſmooth ſurface. The mode of forming the ſocks is upon a laſt, conſiſting of five pieces, (as deſcribed in the drawing,) and a key, which ſerves the double purpoſe of connecting and ſeparating, by ſcrewing into the perpendicular and oblique centre pieces alternately, which, when withdrawn, permit the others to be taken out, when the ſock is ſufficiently dry: the bottom of the gut makes the neateſt ſock. Thoſe who from gout, or any other complaint, wiſh to en-

velope

velope the foot or limb with a greater quantity, may make uſe of the entire ſkin, as a roller, which will exclude the humidity from the ſurface of the earth; and, when rendered adheſive by any proper application, from excluding the atmoſpheric air, may be uſed with effect in the dreſſing of certain wounds. The ſocks may be covered with any varniſh that ſufficiently reſiſts heat and moiſture. A ſolution of elaſtic gum; the compoſition mentioned in Mr. Bellamy's ſpecification for preparing leather *, or ſome of the ingredients and proportions in it; and Mr. Angell's Britannia elaſtic gum †, if with conſent or purchaſe from the patentees, and if not, the ſame ingredients, or ſome of them, ſo modified (which may be done with effect) as not to interfere with any legal right of others. This is mentioned from the infinite changes that have been ſpecified in different patents, as it is well known to be impoſſible almoſt to ſuggeſt any thing which muſt not approach to one or the other. The elaſtic gum I can prove to have uſed for more than a year before I knew there was a patent for it, and have found that ſeveral preparations of it, oil, glue, wax, litharge, amber, roſin, and birdlime, an-

* The ſpecification of Mr. Bellamy's patent is given in our firſt volume, page 73.

† The ſpecification of Mr. Angell's patent is given in our third volume, page 381.

ſwer the purpoſe. I have uſed with effect, one quart of beſt Dutch linſeed oil, one ounce and a half of litharge, one ounce and a half of amber, one ounce and a half of gypſum, and two ounces of the inſpiſſated juice of holly, boiled to a proper conſiſtency, over a ſlow fire. On the manner of boiling, and the quality of the oil, (the firſt of which can only be attained by practice,) chiefly depend the fitneſs of the compoſition, and it muſt be varied according to the ingredients.

The ſecond object is effected, by confining upon the ſurface of the body, or cooling and diluting with atmoſpheric air, the vapour produced by water, or any ſubſtance that may be combined with it, or the fume of dry ſubſtances alone, and preventing the vapour or fume from coming into contact with the lungs. This is to be done by an apparatus, either ſtationary or portable; the firſt in a room or rooms, of ſuitable dimenſions, according to the number of baths, or in a room contiguous, by means of a pipe. A boiler or ſteam-veſſel is to be fixed, adapted in quality and ſize to the ſubſtance it is to receive. In the boiler is to be inſerted, at the top, or in a dome, if ſo made, a ſtop-cock with two pipes, one projected in a right line, the other ſtanding at a right angle, and ſo conſtructed that one muſt be always open. The firſt is

to

to communicate, by a tube, with the lower part of a reſervoir, of which the top and bottom are to be of tin, copper, or wood, and the ſides of ſilk, linen, leather, or other flexible ſubſtance, varniſhed with the ſame ſubſtance before mentioned, or any other which will retain the vapour. The other pipe is to connect with a tube which ſhall diſcharge into the open air, through a perforation in the wall of the chamber. In the ſide of that reſervoir, at the bottom, is to be inſerted the pipe of a pair of bellows, with a conical valve and ſpiral ſpring on the pipe, as deſcribed in the drawing, and compreſſing by aſcent, like thoſe of a blackſmith. To the hole in the bellows, where the air is inhaled, is to be attached a flexible tube, made air-tight, and leading to the outſide of the chamber, to introduce atmoſpheric air. On the top of the reſervoir is to be placed a ſmall frame, as deſcribed in the drawing, in which a thermometer is to be ſuſpended, the ball of which is to be expoſed to the contents of the reſervoir, by a tube of varniſhed ſilk, at one end bound on it, and the other nailed over an aperture beneath the frame. The lever of the bellows is to be directed to this place, to which alſo is to be conducted the bight of a cord, the ends of which are to be faſtened to thoſe of a bar acroſs the key of the ſtop-cock, where it is to act

on

on the principle by which the rudder of a Thames wherry is managed; whence one man can govern the cock with one hand, and with the other give action to the bellows, his eye fixed, at the ſame time, upon the thermometer. At the end of this reſervoir, a few inches diſtant, is to be placed the bathing veſſel, of tin, wood, marble, or any fit ſubſtance; about two thirds of which are to be covered, and on the other to be fixed a circular rim, with a groove upon the outſide, to receive a circular piece of ſilk, varniſhed as before mentioned, and cloſely bound on; the other end folded back, looſe, until in uſe: this veſſel is to be connected with the reſervoir, by a ſtop-cock, with a long pipe. In the inſide of the bathing veſſel is to be inſerted the end of another tube, which ſhall communicate with the external air; terminating with a conical valve, acting by a ſpiral ſpring, or any other which will yield to the force with which the contents may be expelled, when the veſſel ſhall be ſurcharged, to produce a renovation of vapour, or from any other cauſe, and then reſume its place. The perſon then who conducts the bath, when the vapour is prepared, proceeds to fill the reſervoir, of which the ſize may be, for accuracy, convenience, and expedition, in a fixed bath, of equal ſize with the bathing veſſel, and, by

by regarding the thermometer, aſcertains to the moſt exact degree, the temperature at which the vapour may be required. That being done, the perſon who is to receive the bath is to be placed in the veſſel, and the ſilk drawn up about his neck, (but not extended,) and bound on with a very elaſtic woollen roller, ſo tight as to retain the vapour, which will not, if properly adjuſted, produce any uneaſineſs or injury: the ſilk being looſe, ſhews, by dilating and collapſing, when the veſſel is full. The cock between the reſervoir and bathing veſſel being then turned, the reſervoir diſcharges its contents, by ſuffering the top to ſink from its own gravity, or additional weight, and thereby diſcharging its contents; which being done, the cock is turned, to confine the vapour: the top is ſuſpended in a frame, by a cord paſſing over two braſs rollers, to which a weight is attached, and on which a ſmall preſſure effects its elevation. If neceſſary, it might be ſo accurately balanced as to riſe by the injection of the vapour and atmoſpheric air; or the top might be fixed, and the bottom raiſed by a lever, as that of the bellows. That being done, the conductor recommences the operation of filling the reſervoir a ſecond time, or as often as may be neceſſary; and, by returning to the cock which ſeparates the bathing veſſel and reſervoir,

evacuates

evacuates and renews the vapour at pleaſure; whence the morbid exhalation from the body is not only kept from coming into contact with the lungs, but uniformly carried off, by means of the valve-tube before mentioned yielding in obedience to the collapſing reſervoir. When vapour is to be applied to a limb, caſes of varniſhed ſilk, linen, or any other flexible ſubſtance, bound at one or both ends, as may be required, which will retain it, may be uſed; or of wood, tin, &c. with caps, like thoſe of the large bath. Where the part, from its ſituation, cannot be conveniently embraced by thoſe means, and it is found neceſſary to act partially upon a very ſmall ſurface of the body, a concave circle, of glaſs, tin, wood, or any ſuitable hard ſubſtance, and of any diameter, with the edges of any convenient form, with ſpherical caps of varniſhed ſilk, is to be made uſe of, applied to the ſkin, and the vapour conveyed to it by a flexible tube, made air-tight, as thoſe before mentioned; and a lateral tube, with a valve communicating with the external air, to renovate the vapour without removing the concave. When the application is to be of conſiderable length, the concave is to be faſtened to the part by elaſtic rollers, attached to the moſt prominent part of it, and by that means accurately and ſteadily compreſſed. When the

the application is to be of ſhorter duration, the concave may be applied by hand; and, by a momentary removal, the vapour renewed, without the aſſiſtance of a lateral tube and valve, if the ſubſtance ſhould be only water, or ſomething equally innoxious, as the quantity of vapour will be ſo ſmall that it would be ſcarcely felt in the atmoſphere of a chamber of moderate ſize, at leaſt by a perſon whoſe lungs were not in a very infirm ſtate; but the firſt method is the beſt, and moſt accurate. When the fume of dry ſubſtances is to be extricated, inſtead of a boiler, a retort, fire-tube, or chafing-diſh, according to the ſubſtance, is to be uſed, and the atmoſpheric air withheld, or admitted, in whatever quantity may be requiſite; which, as well as any other, may be aſcertained, if neceſſary, by bags of varniſhed ſilk for the purpoſe. Or, what will be a more expeditious mode, either to collect or emit by bellows, of which the contents have been meaſured, with a valve on the pipe; as the flexible tube, communicating with the air hole of the bellows, being introduced into any other body of air or vapour, it may be drawn in and injected with equal facility and diſpatch; and a ſpring bolt or catch may be impoſed, to act when the bellows are extended, to keep them ſo, and prevent any force upon the valve or poſſible eſcape.

The portable bath is made upon the same general principle, with the following difference: the boiler need not contain more than three or four quarts, which will suffice for any ordinary purpose of vapour bath, and is large enough to contain the other necessary apparatus, for which it forms a convenient case. The things required are, first, the tubes, all of which must be flexible, made of thin leather, or linen, varnished, closely bound round brass spirals of a proper diameter. The cock, as described before, with a tube, which is to fit at one end by a screw, or well ground, the former into the boiler, the latter into a tin or copper vessel, large enough to contain and form a travelling covering for the boiler, which, from its frequent exposure to the fire, requires one. This vessel for fume is immersed in one with water, if required, but serves here as a reservoir, to blend the two bodies, and transmit them in one uniform current, through a small tube, to a bag of varnished silk, sufficiently large to envelope the whole, or any part of the body that may be required: when for the entire body, it is to be bound round the neck, as in the other bath; for a limb, at each end. To the side of this also, as in the former, is to be attached a tube, leading to the window, chimney, or key-hole, of the chamber: when to the former, it should terminate with a conical screw,

which

which ſhall have way made for it by a gimblet, ſhould none other appear. The only difference between the baths, in effect, is, that in the portable bath the bellows are wrought by hands, or one, if neceſſary, from an inward elevating ſpring; and that the diluted vapour is forced, without interruption, through an open tube, upon the body, without waiting for the preparation of a quantity equal to fill the whole bath. The bag where the vapour is to be received may be round at bottom, or might terminate in a cone, about three feet in length, to let the greater volume approach the body at once, which, even without an intermediate veſſel, would materially prevent expoſure to the partial ſtreams of air and vapour, which I have found effectual with care. The dilating and collapſing of the ſilk will tell when the bag is full, or otherwiſe; at which time, the cock is to be turned, and the vapour is carried off, as in the other bath, and the bellows ceaſe, until it is found neceſſary to renovate. By theſe means the effect of the vapour is equal to that produced by the ſtationary bath, ſave only that of the preparation of the vapour in a larger volume, which, where ſpace cannot be conveniently found, may be there alſo diſpenſed with; as, by a very moderate degree of experience or attention, a ſmaller reſervoir will ſuffice; and

even the immediate introduction of the vapour and air ſeparately into the bath, and the dilution being therein performed, could not, without great miſmanagement, produce any inconvenience; and the perſon bathed might in either caſe command both ſtreams himſelf, by two cocks, as in a common warm-water bath. In either of theſe caſes, the thermometer is to be ſuſpended by a riband about the neck of the perſon bathing, and the ball expoſed to the vapour by a tube of ſilk, as before deſcribed; by which means it is viſible to the patient, or operator. In an apparatus where the vapour is to be blended in the bath, the lever of the bellows is to be moved by the foot of the conductor, preſſing on a ſtirrup attached to the end of it; by which means he has a hand diſengaged for each cock. The ſame convenience may be had in uſing the portable bellows by the motion of the arm, and being faſtened as thoſe of bagpipes. By either of the baths, the means propoſed for the recovery of drowned perſons, by the Humane Society, may, it is ardently hoped, be materially augmented; and in thoſe, as well as ſeveral other caſes, the evaneſcent ſcintillations of life ſucceſsfully excited.

The third method is, by augmenting the effects of Ether, by continuing the application of it to any

any part of the body, without the loſs, by evaporation, which attends the other methods. That is to be effected by the means of a very flat concave, as deſcribed in the drawing, with two necks in the circumference, oppoſite to each other. Into each of theſe are to be accurately fitted, by grinding, the necks of two flat phials, of equal contents with the concave. In theſe are to be inſerted, tranſverſely, two plugs, perforated as that of a ſtop-cock, which, being turned, open or cloſe the paſſages. The upper phial being filled with Ether, or any other volatile or ſtimulatory fluid, and the edges of the concave being brought into cloſe contact with the ſkin, either by hand or by elaſtic bandages, the plug is turned, to ſuffer the Ether to deſcend into the concave, where it is confined upon the ſkin, until the other is turned to admit it into the lower phial, where it is kept for uſe at another time, with very little waſte, unleſs from accident. In the bottom of the upper phial is to be inſerted a ſmall ſtopper, to admit air, when the Ether is deſcending.

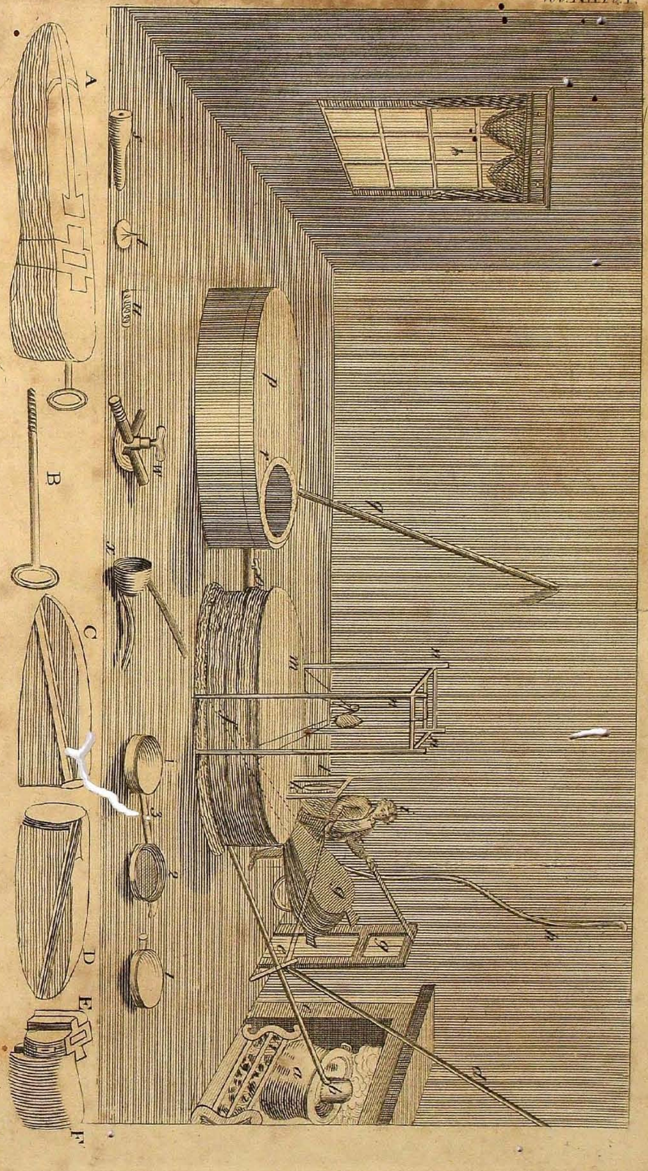
It may be right to obſerve, that when the fume of dry ſubſtances ſhould require to be cooled, I have alſo paſſed it through a coiled tube immerſed in a pail of cold water; and, to ſave ſome part of the time in changing the

the water when it became heated, I have uſed a ſyphon, which carries off the hot water, and is ſupported by three legs, which are, as the tubes of the ſyphon, connected by ſcrews, to render it more portable. In ſtationary baths, a cock in the veſſel that contains the tube, and one in a large elevated reſervoir, anſwers the purpoſe.

Description of the Figures.

(See Plate I.)

a, the boiler. *b*, the dome. *c*, the tube leading to the reſervoir. *d*, another tube, communicating with the atmoſpheric air, by a perforation in the wall of the chamber. *e*, a ſtop-cock, with two pipes, one of which connects with that tube, the other projecting to the bottom of the reſervoir *f*. *g*, *g*, frame and bellows, compreſſing by aſcent. *h*, a flexible tube, attached to the air-hole of the bellows, and leading, as the other, to the atmoſphere. *i*, the conductor of the bath, with the lever of the bellows in one hand, and the bight of the cord in the other, that governs the cock, looking on the thermometer *k*, ſuſpended by the frame *l*. *m*, the top of the reſervoir, ſuſpended by the frame, cords, &c. *n*, *n*, *n*. *o*, the tube and cock, which admit


A
B
C
D
E
F

admit prepared vapour into the bathing veſſel *p*. *q*, a tube, with a conical valve, which carries off the vapour when the bath is ſurcharged, for the purpoſe of renovation. *r*, the ſilk bound round the brim of the bathing veſſel. *s*, the receiver of the conical valve. *t*, the conical valve. *u*, the ſpiral ſpring which ſupports it. *w*, the cock, with two pipes. *x*, the concave glaſs, for topical application, with the tube to receive the vapour; and one valved, to carry it off from a lateral aperture.

1, 1, two flat phials, to contain Ether. 2, the flat concave. 3, the tranſverſe ſtock plug in the neck of the upper phial: the lower phial is deſcribed detached.

A, the laſt, connected. B, the key. C, the oblique centre-piece. D, the ſides. E, the perpendicular centre-piece. F, the heel.

In witneſs whereof, &c.

II. *Specification of the Patent granted to Mr.* Joseph Haycraft, *of Greenland Dock, Rotherhithe, Block, Pump, and Gun-carriage maker; for a Gun-carriage upon a new Construction.*

WITH A PLATE.

Dated March 23, 1798.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Joseph Haycraft do hereby declare, that my said invention of a gun-carriage upon a new construction, is fully described and explained in the drawing and description annexed. In witness whereof, &c.

The improved gun-carriage has three particular designs or advantages connected, *viz.* the occupying of less room or space; the greater ease and facility with which it may be worked or traversed; and the having less recoil at firing the gun. The occupying less room is obtained, and the principle

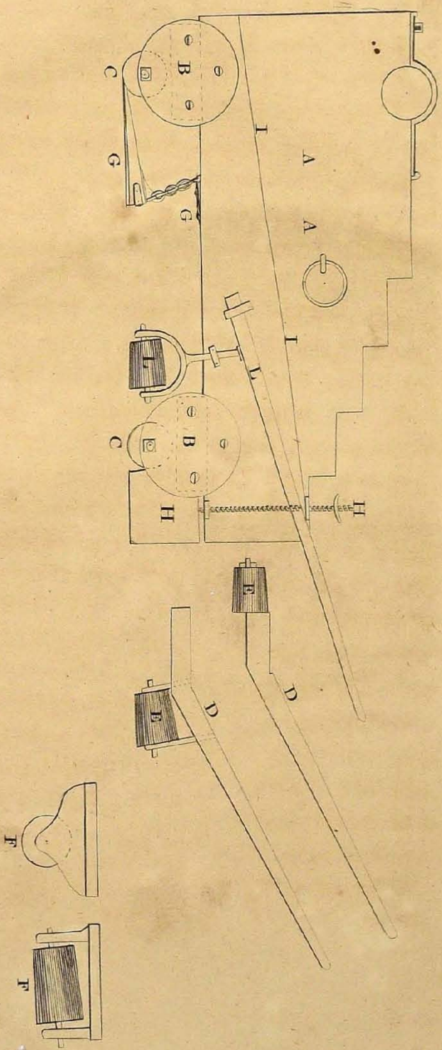
ple thus deſcribed. Let A A (Plate II.) be a right ſection of the carriage, and B, B, the places where axletrees are commonly fixed. I there ſubſtitute plates, bolſters, or cleats of iron, metal, wood, or any other hard ſubſtance, of ſufficient ſtrength, and of any ſhape that neceſſity may dictate, ſecured to the carriage A A by ſcrews, bolts, rivets, or any other way that may be required. To which plates, &c. I ſecure rollers, wheels, or trucks, C, C, under the carriage, the axle paſſing through, or ſecured to, the plates, &c. The ſaid rollers, wheels, or trucks, to be made of lignum-vitæ, iron, metal, or other hard ſubſtances.

The traverſing the carriage is performed by conical or cylindric caſters, or ſpherical rollers, &c. applied in a tranſverſe direction. I recommend them to be fixed to the hand-crow-lever, as repreſented in different forms at D, D; the rollers, E, E. By which invention, one man may traverſe an eighteen pounder gun with great eaſe. Or the rollers may be fixed in frames, as F, F; or may be attached to the carriage in different parts, and kept from the ſurface by means of a ſpring, or otherwiſe; and acted upon, or brought in uſe, by a common lever, as repreſented at L L; or by the ſcrew, or any other power applicable.

To prevent the recoil of the gun, particularly when firing to windward, I adopt a ſhoe, made

in form of a wedge, as G G, attached to the carriage by a chain, or any other ſuitable way. The carriage, on the recoil, has to aſcend this wedge or ſhoe: by this method the operation of the trucks is taken away. At H H the ſame effect is ſhewn, by means of a bolt paſſing through the carriage into a chuck or bolſter, which is acted on by a ſcrew. The recoil may be likewiſe much impeded by making the carriage in two parts, with a riſing plane, as repreſented by the line I I; the upper part, at the recoil, having to aſcend the lower, which may be effected with great ſafety by tongues and grooves, plates and cleats.

It may be proper to add, that the hand-crow-lever, with conical (or other) rollers, as repreſented at D, D, and E, E, is applicable to move any weight or thing that requires a total or partial revolution.


A
A
B
B
C
C
D
D
E
E
F
F
G
G
G
H
H
I
I
L
L

III. *Specification of the Patent granted to Mr.* JAMES KNOWLES, *of the Pariſh of St. Mary, Lambeth, in the County of Surrey, Leather-dreſſer; for his Invention of a new Mode or Method of dreſſing or preparing of Skins, for the Purpoſe of converting them into Leather, whereby much Trouble, Labour, and Expence, are ſaved.*

Dated April 27, 1799.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that in compliance with the ſaid proviſo, I the ſaid James Knowles do hereby declare, that my ſaid invention is deſcribed in manner following; that is to ſay: When the wool or hair is pulled or taken off the ſkin, the ſkin or pelt (a name uſually given to the ſkin in that ſtate) is ſimply dipped into water, and then undergoes the operation of fleſhing. The ſkin or pelt is then dipped again into water, and undergoes the operation of ſtudding or ſtriking; after which, it is in a ſtate fit to be tanned,

tawed, or dreſſed. Fleſhing, and ſtudding or ſtriking, are operations ſo well known in the trade, that I think it needleſs to deſcribe them. This method occupies much leſs time than thoſe heretofore practiſed; which conſiſted of, firſt, immerging the ſkins in lime-pits, where they were depoſited for a conſiderable time, and were afterwards neceſſarily obliged to be drenched or cleared of the lime. The eſſence of this invention conſiſts in omitting the proceſſes uſed in the old method of liming and drenching, which not only retard the progreſs of the ſkins towards leather, but injure its quality; yet, where the ſkins or pelts are in a ſtale ſtate, and workmen not at hand, or from any other cauſe they cannot be immediately worked, they may, merely for the temporary preſervation of them, be thrown into water in which a ſmall quantity of lime is infuſed, and worked from that water by my operations above deſcribed; but lime is not neceſſary in any other caſe. In witneſs whereof, &c.

IV.

IV. *Specification of the Patent granted to Mr.* John Hayes, *of the Pariſh of Workingham, in the County of Wilts, Gentleman; for his Invention of certain Machines or Inſtruments for the Cultivation and Tillage of all Kinds of Land, upon a very eaſy and cheap Conſtruction.*

WITH A PLATE.

Dated June 18, 1799.

To all to whom theſe preſents ſhall come, &c. Now know ye that, in compliance with the ſaid proviſo, I the ſaid John Hayes do hereby declare, that my ſaid invention is deſcribed in the drawings and deſcriptions annexed. In witneſs whereof, &c.

No. 1. (ſee Plate III.) a machine or inſtrument to cleanſe meadows from moſs, &c. and to cut the ſurface of untilled land, in order to bring it into tillage. A A A A, the frame. B, B, the ſhafts. C, C, joints on which the ſhafts move, as in No. 15. D D, the roller, as ſeen at No. 17. E, E, two regulators, more fully ſhewn by No. 16, fitted into the grooves *a*, *a*, by means of a pin, to riſe or fall the roller, as occaſion may require. *b*, *b*, fixed centres, on which the roller hangs.

hangs. F F, an inclined plate of iron, to ferve as a fcraper for cleaning the roller, to be adjufted clofer or farther from the roller when neceffary, as feen at No. 18. G G, a plate of iron, fcrewed acrofs the frame, with a number of fquare holes, for receiving the iron or fteel inftrument No. 19, faftened by means of fcrew, pin, &c. H, H, handles for the workman to keep the machine or inftrument fteady. I, I, I, I, braces for ftrengthening the frame.

No. 2, a machine or inftrument to cleanfe the furface of land from ftubble, weeds, couch, &c. in order to its being burnt or carried off. The frame, roller, fcraper, braces, &c. as No. 1. A A, A A, two plates, for receiving a double row of chifel-pointed inftruments, as No. 20. B, B, two handles, fixed to the frame by means of the joints C, C. D, D, two circular plates, for raifing or falling the handles, for the convenience of the workman.

No. 3, a machine or inftrument to rake the weeds, ftubble, &c. into heaps, to be burnt, &c. The frame, roller, fcraper, braces, &c. as No. 2, with barbed inftruments, No. 21, to be ufed therein, which are for the purpofe of gathering weeds, &c. together.

No. 4, the coulter plough, to cleanfe the foil from couch, &c. and prepare the land for No. 5. The frame, &c. as No. 2, with arrow-pointed inftruments to be ufed therein, as No. 22.

No.

No. 5, the plough. The frame, &c. as No. 2; into which introduce the inſtruments Nos. 22 and 23, to be placed as in No. 5.

No. 6, a machine or inſtrument to harrow the land, and cover in the ſeed. The frame, &c. as No. 2, into which are introduced iron or ſteel teeth or inſtruments, as No. 24.

No. 7, to open the drills. The frame, &c. as No. 2. A, A, two handles, fixed to the ſides of the frame, interſecting each other in the middle of the back bar, to bring the preſſure on the middle of the work; they riſe and fall by means of joints and curved iron, as No. 2. Theſe handles are extended, to prevent the workman walking on and damaging the drills after they are opened. No. 25, the inſtrument, &c. introduced into No. 7.

No. 8, a machine to roll and harrow in graſs ſeeds, &c. The frame, roller, &c. in the ſame proportion as No. 2, in which are three bars, for the reception of a number of buſhes, to harrow the ſeeds in, and finiſh the land.

Nos. 9, 10, and 11, machines or inſtruments to plant the ſeeds on three, four, and five bout lands, with four iron bars, which form the joints A, A, A, A, for the expanſion and contraction of the machine, as the width of the furrow may require, by means of four ſmall pins, *b*, *b*, *b*, *b*. Into No. 9 introduce two double rows of inſtruments, as No. 24.

In

Into No. 10 introduce inſtrument No. 25.

Into No. 11 introduce inſtruments Nos. 22 and 23.

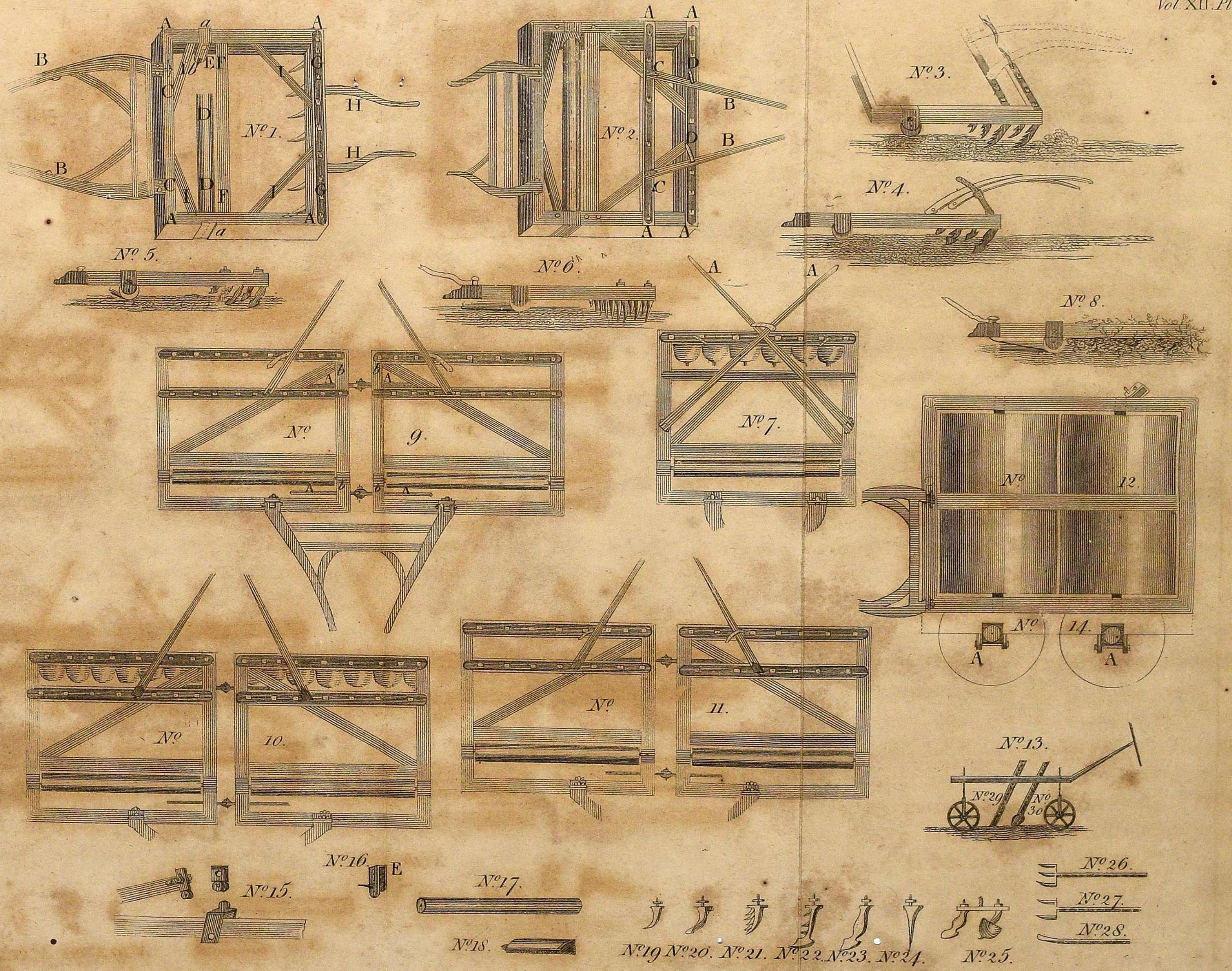
No. 12, a double roller, fixed in the frame, as clearly ſeen at No. 14, made to take in and out by means of two bolts A, A. This roller may be made ſquare or oblong, as may appear to be moſt uſeful.

No. 13, a machine or inſtrument to deſtroy the weeds between the rows of corn.

No. 29 is a coulter or inſtrument for cutting the ground for No. 30, a hoe for cutting and clearing away the weeds; it ſhould be made to anſwer the width of the rows of corn.

Nos. 26, 27, and 28, are inſtruments to be uſed diſcretionary, in place of No. 29, when the nature of the work to be done requires it. This machine or inſtrument is regulated in the ſame manner as a common wheel plough, as appears by the dots in the ſeveral implements.

The above machines or inſtruments may be made of any proper materials, on a larger or ſmaller ſcale, and may contain more or leſs of the inſtruments or implements Nos. 19, 20, 21, 22, 23, 24, 25, according to the ſize of the machines, the nature of the work required to be done, and the number of horſes intended to be employed.



No. 1.
No. 2.
No. 3.
No. 4.
No. 5.
No. 6.
No. 7.
No. 8.
No. 9.
No. 10.
No. 11.
No. 12.
No. 13.
No. 14.
No. 15.
No. 16.
No. 17.
No. 18.
No. 19
No. 20.
No. 21.
No. 22.
No. 23.
No. 24.
No. 25.
No. 26.
No. 27.
No. 28.
No. 29
No. 30

V. *Experiments to determine the Quantity of tanning Principle and gallic Acid contained in the Bark of various Trees.* By GEORGE BIGGIN, *Esq.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

THE bark of trees contains the aſtringent principle, called gallic acid, and alſo that principle which has a peculiar affinity to the matter of ſkin, and which, from the uſe to which it is applied, is called the tanning principle. But, in the preſent mode of tanning, bark is applied in *maſs* to the ſkins; conſequently, *both* principles are applied. It remains for examination, whether both principles are uſeful in the proceſs of tanning; for, if they are not both uſeful, probably *one* is detrimental.

To a nobleman whoſe zeal on every occaſion by which the ſciences or arts may receive illuſtration or improvement is eminently conſpicuous, and to whoſe public energy, as well as private friendſhip, I feel myſelf much indebted, to his Grace the Duke of Bedford, I owe the means of

 proſecuting

prosecuting some experiments on this subject. His Grace, by collecting a variety of barks, at Woburn, gave me an opportunity of making some experiments to ascertain the quantity of tanning principle and gallic acid each bark contained. For that purpose, I made use of the following methods, according to the principles laid down by M. Seguin.

By dissolving an ounce of common glue in two pounds of boiling water, I procured a mucilaginous liquor, which, as it contains the matter of skin in solution, is a test for the tanning principle. By a saturated solution of sulphate of iron, I obtained a test for the gallic acid.

I then took one pound of the bark I meant to try, ground as for the use of tanners, and divided it into five parts, each part being put into an earthen vessel. To one part of this bark, I added two pounds of water, and infused them for one hour. Thus I procured an infusion of bark, which I poured on the second part of the bark, and this strengthened infusion again on the third part, and so on, to the fifth. But, as a certain portion of the infusion will remain attached to the *wood* of the bark, after the infusion is poured or drawn off, I added a third pound of water to the first part, and then followed up the infusion on the several parts, till the three pounds of water, or so much of them as could be separated

rated from the bark, were united in the fifth veſſel; from which I generally obtained about one pint of ſtrong infuſion of bark *.

To a certain quantity of this infuſion, I added a given meaſure of the ſolution of glue; which formed an immediate precipitate, that may be ſeparated from the infuſion by filtering paper. When dried, it is a ſubſtance formed by the chemical union of the matter of ſkin with the tanning principle, and is, in fact, a powder of leather. By ſaturating the infuſion with the ſolution of glue, the whole of the tanning principle may be ſeparated by precipitation.

For the Gallic Acid.

To the pound of bark left in the earthen veſſels, and already deprived of its tanning principle by theſe *quick* infuſions, I added a *given* quantity of water, to procure a ſtrong infuſion of the gallic acid, which requires a longer time, (ſay forty-eight hours.) This infuſion, when obtained pure †, affords little ſigns of the preſence of

* The ſpecific gravity of this infuſion was aſcertained by an hydrometer whoſe gradations are inverſe to thoſe of a ſpirit hydrometer.

† It is hardly poſſible, from the intimate connection of the two principles, to ſeparate them entirely by infuſion: in the infuſion of tanning principle, there will always exiſt a little

of the tanning principle, when tried by the teſt of the ſolution of glue; but, with the ſolution of ſulphate of iron, it gives a ſtrong black colour, (the common black dye,) which differs in denſity, according to the quality of the bark: this may be further proved, by boiling a ſkain of worſted in the dye, by which the gradations of colour will be very perceptibly demonſtrated.

Having thus obtained a point of compariſon; by making a ſimilar infuſion, under ſimilar circumſtances, of any bark, or vegetable ſubſtance, and paying ſtrict attention to the ſpecific gravity of the infuſion, the quantity of precipitate of leather, and the denſity of colour produced by given quantities of one or the other teſt, the reſult will be, a comparative ſtatement of the reſpective powers of any bark, or vegetable ſubſtance. This comparative ſtatement, I conceive to be ſufficient for all commercial purpoſes.

As oak bark is the uſual ſubſtance employed in the trade of tanning, if a quantity of tanning principle is found to be contained in any other bark or vegetable, the commercial utility of that bark or vegetable may be determined, by comparing its quantity of tanning principle and price with thoſe of oak bark.

little gallic acid; and, in an infuſion of gallic acid, a little tanning principle will commonly be preſent, unleſs the infuſion of gallic acid is very weak, and procured by a third or fourth watering.

For

For an accurate chemical analyſis, I have tried a variety of acids, and ſimple and compound affinities; and, having purſued the above experiments at the ſame time that I was employed on ſome in dying, I found the muriate of tin (the method of uſing which is deſcribed by Mr. Prouſt in the *Annales de Chimie)* very convenient. A ſolution of it, being added to the infuſion of bark, forms a precipitate with the tanning principle, leaving the gallic acid ſuſpended: the precipitate is of a fawn colour, and is compoſed of tanning principle and oxidated tin.

By theſe means, I have been enabled to form a comparative ſcale of barks; which, however, I do not produce as accurate. Oak bark, in its preſent ſtate, as procured for commercial purpoſes, differs very much in quality, from accidental circumſtances: the ſeaſon of the year in which it is collected occaſions a ſtill more important difference, conſequently, the ſcale now produced muſt be very imperfect; but I am of opinion, that by the purſuits of ſcientific men who may be inclined to inveſtigate this ſubject more fully, a very accurate ſcale may hereafter be formed.

In the following ſcale, I have taken Sumach as the moſt powerful in the comparative ſtatement; leaving, however, a few degrees, for a *ſuppoſed maximum of tanning principle,* which I reckon 20.

SCALE OF BARKS.

Bark of	Gallic acid, by colour.	Tanning principle, by hydrometer.	Tanning principle, (in grains,) from half a pint of infusion and an ounce of solution of glue.
Elm *	7	2,1	28
Oak, cut in winter	8	2,1	30
Horſe cheſnut . .	6	2,2	30
Beech	7	2,4	31
Willow (boughs) .	8	2,4	31
Elder	4	3,0	41
Plum-tree	8	4,0	58
Willow (trunk) .	9	4,0	52
Sycamore . . .	6	4,1	53
Birch	4	4,1	54
Cherry-tree . .	8	4,2	59
Sallow	8	4,6	59
Mountain aſh . .	8	4,7	60
Poplar	8	6,0	76
Hazel	9	6,3	79
Aſh	10	6,6	82
Spaniſh cheſnut .	10	9,0	98
Smooth oak . .	10	9,2	104
Oak, cut in ſpring	10	9,6	108
Huntingdon or Leiceſter willow .	10	10,1	109
Sumach	14	16,2	158

* The infuſion of elm was ſo loaded with mucilage, that t was with difficulty I could ſeparate the tanning principle, or try the ſpecific gravity.

It

It is to be obſerved, that the barks do not keep any reſpective proportion in the quantity of gallic acid and tanning principle contained in each; which is an evidence of the diſtinctneſs of principle, and may perhaps open a new field for ſaving oak-bark in dying, as the willows, fallow, aſh, and others, produce a very fine black. It is alſo worthy of obſervation, that the quantities of gallic acid and tanning principle do not differ in *equal* proportions, between the winter and ſpring felled oaks. This fact may lead to the diſcrimination of the proper time for cutting; which is, probably, when the ſap has completely filled and dilated that part of the vegetable intended for uſe. This will make a difference in the ſeaſon of cutting oak, elm, and other trees, ſhrubs, &c. Leaves ſhould be taken when arrived at their full ſize, and then dried under cover; for, as the tanning principle is ſo ſoluble, and the ſubſtance that contains it ſo thin, (in a leaf,) the dew alone might diſſolve it.

Finally, as the gallic acid does not ſeem to combine with the matter of ſkin, and as its aſtringency will corrugate the ſurface, we may, I think, conclude, that its preſence in tanning is not only uſeleſs, but detrimental.

VI.

VI. *Experiments made with a View to ascertain the Truth and Importance of Dr.* Hunter's *Opinions respecting the Food of Plants. By Major* Thomas Velley.

From the Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture, &c.

THE laudable exertions of the Board of Agriculture having called forth various expedients, both from the practical and theoretical improvers of land, for the advancement of cultivation in general, I selected, from among sundry tracts recommended by the board, the one intituled, "The Outlines of Agriculture," published by Dr. Hunter, the learned editor of Evelyn's Sylva; in which work the above-mentioned tract made its first appearance, in the form of a note. In the seventh page of the pamphlet, the ingenious author thus expresses himself; "I lay it

"down

" down as a fundamental maxim, that all plants " receive their principal nourishment from oily " particles incorporated with water, by means " of an alkaline salt, or absorbent earth." Having supported this hypothesis by various arguments, he notices a preparation as follows.

" One drachm of Russia potash dissolved in " two ounces of water, then add two spoonfuls " of oil; p. 19."

This mixture, the author asserts, " is adapted " to all the purposes of vegetation."

Pleased with the information, I determined to give the fairest trial to the experiment, and chose a piece of ground which was fresh, and had not received any manure: in this I made six contiguous beds. I then marked out, in each bed, 128 spots, four inches asunder every way. In the first bed I planted the same number of barley seeds, which had been steeped three days in the above mixture. After this, I planted, in the same manner, and in the adjoining bed, the same quantity of seeds, *dry*, and *not steeped*; but, before the soil was closed upon them, I poured into every hole two-thirds of a drachm of the said composition; a quantity so small as scarcely to fill a tea-spoon, and which could not have been supposed to produce any visible effect. I then

 planted,

planted, in the third bed, the ſame number of ſeeds in their natural ſtate, *unprepared*, and *without any compoſition.*

The following obſervations I made with great accuracy. The ſeeds which had been ſteeped did not make their appearance ſo ſoon, by eight or nine days, as the grain which had been planted *without any* preparation. Thoſe ſeeds upon which the mixture had been poured continued *ſtill longer* in the ground, inſomuch that I thought they had been entirely deſtroyed; at laſt, however, they came up, though but ſparingly, and leſs in quantity than thoſe which had been ſteeped; but both ſorts were far leſs productive than thoſe which had been *totally unprepared.* The laſt produced near double the quantity to the next beſt; as will appear from the annexed accounts of the relative productions of the different beds.

I repeated the ſame experiment with oats, in the ſame manner as before ſtated, in every reſpect, and planted them in the three adjoining beds; and it was ſingular enough to obſerve the ſame effects preciſely, as to the time of their coming up, and of their ripening, as well as with regard to their produce, which I had before remarked in the barley. In both inſtances, the *unprepared* grain was much more forward in

its

its appearance and ſtate of maturity, as alſo much more abundant, than either of the other two.

All the ſeeds were planted with the Norfolk dibble, exactly at the ſame depth, at the ſame time, and in adjoining beds, under the ſame aſpect, in an open though rather loamy ſoil, which had not been manured.

Table of the relative Productions of Grain, as noticed in the above Account.

	Ears.
Barley, *ſteeped*, eight or nine days more backward than the *dry* grain, produced .	465
Barley, *not ſteeped*, but having a ſmall quantity of the mixture poured into the hole with it, was ſtill longer in the ground than the former, and produced	236
Barley, *unprepared*, came up eight or nine days ſooner than the firſt, and produced	750
Oats, *ſteeped*, were ſeven or eight days more backward than the *dry* grain, and produced	159
Oats, *not ſteeped*, but having a ſmall quantity of the mixture poured into the hole	

Ears.

with them, were longer in the ground than the former, and produced 103

Oats, *unprepared*, came up seven or eight days sooner than the first, and produced 238

An objection may possibly be made to the small scale upon which the essay has been brought forward: yet, as the effects produced by the composition, and by the varied modes of applying it, were remarkably similar in the different sorts of grain, planted at the same time, and in the same soil, I think such an objection cannot reasonably invalidate an experiment of this nature; more especially when it is considered, that a greater degree of accuracy and precision can accompany similar attempts upon a smaller scale, than when extended to a greater scope; and, if I am not greatly mistaken, some of the very ingenious observations which the learned chemist Dr. Ingenhousz has lately given to the world, with respect to the nutriment and support of vegetable life, have been founded upon experiments even more confined in their extent, though not less worthy of attention on that account, than those above cited.

VII.

VII. *Experiments and Obſervations on various Kinds of Manure.* *By* JOHN MIDDLETON, *of Lambeth, Eſquire.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal of the Society was voted to Mr. MIDDLETON, for theſe Experiments.

HAVING made experiments with various kinds of manure, on a farm of which I am the owner and occupier, ſituate at Merton, in Surrey, for the purpoſe of aſcertaining the moſt appropriate dreſſing for the ſoil which is a tenacious loam, on a ſubſtratum approaching towards yellow clay, I am induced, by the regard I feel for the ſucceſs of Britiſh agriculture, to lay the following obſervations on the ſeveral experiments before the Society for the Encouragement of Arts, Manufactures, and Commerce, for their conſideration. I hope and believe that they will be found not altogether unworthy their attention.

1. *Peat*

1. *Peat Aſhes*, from Newbury, Berks. Of theſe aſhes I have ſpread, in various quantities, *per* acre, fifteen hundred buſhels, on wheat, tares, ſeeds, and meadow land, without being able to diſcern any beneficial effect from them.

2. *Coal Aſhes*, ſpread on three or four acres of graſs land, in March, 1798, produced no viſible effect at *mowing time*, nor have I *ſince* obſerved any.

3. *Wood Aſhes*, the produce of my own fires, when ſpread on the graſs, in February, or early in March, I have found to be of ſome though little ſervice.

4. *Malt Duſt*, including the duſt from the malt-kilns, I uſed for two or three years, to an extent ſufficiently great to aſcertain that the benefits produced by the uſe of it are conſiderable. It may be applied in ſuch a quantity as to inſure *one large crop*; but, on meadow land, even when hay is at five pounds a ton, it only repays the prime coſt.

The quantity which I have uſually laid on, has been in the proportion of from fifty to ſixty buſhels *per* acre. The firſt coſt of kiln-duſt is ſix-pence, and of malt-duſt eight-pence, *per* buſhel: including the expence of carriage, and ſpreading this dreſſing on the land, it amounts to about two guineas *per* acre. The extra crop returned me this ſum, but without profit.

5. *Soot.*

5. *Soot.* Of this manure I ſpread eight hundred buſhels over twenty acres of wheat, in one year; but I could not, from the ſubſequent appearance of the crop, diſcover whether the increaſe in quantity was equivalent to the additional expence. However, it was evidently of ſome uſe; but to what extent, would require more than bare inſpection to aſcertain. By way of compariſon, ſome of the ridges were left without ſoot: they were at harveſt ſcarcely to be diſtinguiſhed from the reſt; but, where the ſoot lay in larger quantity than ordinary, as was the caſe in the places at which the loads had been ſhot from the carts, the ſuperior vegetation was very diſtinctly marked. I have, on the whole, formed the ſame opinion with reſpect to this ſpecies of manure, as I have already ſtated in regard to malt-duſt, namely, that it returns the coſt price, with very little profit.

6. *Soap-maker's Waſte.* I have tried only one load of this manure, on a few rods of ground, in four of my meadows. It has not produced the leaſt effect, although it is now three years ſince it was laid on. Soap-maker's waſte, potaſh, and barilla, are probably held in too much eſteem, as preparers of the food of plants, by philoſophical chemiſts, of whom it might be wiſhed that a little *practice* were combined with their *theoretical* ideas on the ſcience of agriculture; and that they would

would try their ſpecious theories by the teſt of experiment, before they publiſh them to the world.

I am farther induced to conſider this kind of dreſſing for land as of much leſs utility than is generally imagined, from having been informed by Mr. Ruſſel, junior, that his father, who is a ſoap-maker of great reſpectability at Paris Garden, has uſed the waſte of his own manufactory on his farms in Eſſex and Kent, (in the latter on a clay ſoil,) without diſcovering that it was of any material benefit to the land; and that he has conſequently diſcontinued the uſe of it.

The experiments made by Major Velley, as reported in the Eighth Volume of Papers publiſhed by the Bath Society of Agriculture, ſeem alſo to prove, that Dr. Hunter's food of plants does not anſwer *any* of the purpoſes for which it has been ſo highly extolled; but, on the contrary, that it is really *hurtful* to corn crops *.

7. *Sweepings of London Streets.* I have uſed ſeveral hundred loads of this manure on graſs land, and have found it to be of conſiderable ſervice to the ſucceeding crops. I have uſually laid it in large heaps, and mixed with it a ſmall quantity of horſe dung: in this ſtate it generates a little heat, though leſs than might be wiſhed, which

* Major Velley's experiments are printed in our preſent number, page 32.

helps

helps to decompose or rot the mixture; when thus prepared, it has been spread on the land, in the proportion of ten or twelve loads *per* acre.

8. *The Soil of Privies.* Within the last four or five years, this manure has been spread on my land, to the expence of about 100 *l.*; the proportion, from two to four loads *per* acre. The effect produced by it was *astonishing fertility*; so much so, as to induce me to be of opinion, that it exceeds every other kind of manure that can be brought into competition with it, at least for the *first year* after it is laid on. In the second, it is of some service; but, in the third year, its effects very nearly or entirely cease. From these premises I draw this conclusion, that, for land in good condition, the application of two loads *per* acre, *per annum*, will continue it in that state for any length of time; and also, that land which has been much exhausted, might be restored by laying on four or five loads *per* acre; after which, a repetition of two loads annually, would be found sufficient to keep it in the highest degree of fertility.

9. *Farm-yard Dung.* This, when it had been once turned, and become about three-fourths rotten, I have used in the proportion of about *thirteen* or *fourteen loads per* acre; and found it much less effective, for *one* year, than *three loads* of

night-ſoil. I believe that even a load and a half of ſoil, would have been equal to the foregoing quantity of dung. In the *ſecond* year, I could not perceive any difference between the dung and the ſoil.

In the laſt volume of the tranſactions of the ſociety, page 168, a crop of wheat, amounting to 56 buſhels *per* acre, is ſaid to have been raiſed by Mr. Henry Harper, of Lancaſhire; which is ſo much above the general average, that Mr. Harper was at a loſs how to account for it. I am inclined to think that the *night-ſoil*, contained in the mixture with which he dreſſed the cloſe, was the cauſe of this *wonderful effect*.

He mentions, that the quantity of manure (conſiſting of *night-ſoil*, coal-aſhes, ſweepings of ſtreets, &c.) was eighty tons, and that the cloſe contains eleven acres: the proportion *per* acre was therefore ſomething more than ſeven tons. He does not ſay what part of this proportion was night-ſoil, but it was probably not leſs than four tons; a quantity which, as I have before obſerved, is ſufficient of itſelf to produce one immenſe crop.

In ſhort, it appears to me that Nature, following her general ſyſtem of re-production, prepares this matter in the moſt perfect manner for the purpoſe

purpofe of feeding vegetables, and raifing them to the very higheft pitch of excellence; and it is certain, that herbage growing under thefe circumftances, is capable of fattening the *largeft* cattle in lefs time than any other.

The importance of this kind of manure being fo evident, I am fure the fociety will feel, equally with me, the moft poignant regret, when they take into their confideration, that ninety-nine parts in every hundred of this valuable article is conftantly and moft *abfurdly* carried, by the fewers and drains, into the rivers, and thereby totally loft to the purpofes of agriculture, for which it is fo admirably adapted.

In Britain alone, the quantity of this manure, and of urine, which is annually thus wafted, is aftonifhingly great; probably not lefs than five millions of cart-loads, worth to the farmers two millions and a half, and to the community five millions of pounds fterling, *per annum.*

This fubject is, I think, well entitled to the attention of the fociety; and it would add much to the credit which they have already acquired by their patriotic labours, if they could devife the means whereby the wafte of this article might be effectually prevented.

VIII. *On Green Crops. By Mr.* PATRICK BRODIE, *of Garvald, near Haddington.*

From the PRIZE ESSAYS of the HIGHLAND SOCIETY of SCOTLAND.

GREEN crops form a very eſſential improvement in huſbandry: by them, variety is introduced into the ſcheme of agriculture; and, by their diverſifying the crops, the buſineſs is greatly facilitated, and promoted. Though their own value, which is confeſſedly great, were out of the queſtion, they have a ſurpriſing effect in cleaning and fertilizing the ſoil, and making it produce ſuch excellent white crops, when ſown in a judicious rotation after them, as muſt aſtoniſh every one who recollects the former ſtate of the fields, with their ſcanty and precarious productions. We may with ſafety aver, that they and ſummer fallow form the greateſt improvements that have been introduced into the huſbandry of this country, during the preſent century. It is, therefore, with peculiar propriety, that a patriotic ſociety holds out premiums to draw

draw forth eſſays on a ſubject that has ſo much improved, and is ſtill likely to improve, the huſbandry of their country. One great bar to practical farmers attempting theſe eſſays, is their want of ſkill in writing. Our ſentences muſt be compoſed in a clumſy manner, either from a wrong choice of words, or a bad arrangement of them. An eſſay written in ſuch a ſtile, though containing good ideas and uſeful matter, muſt be read with leſs profit and ſatisfaction, than compoſitions leſs inelegant.

Senſible, however, as I am of my own deficiency in theſe reſpects, I ſhall, without farther apology, hazard ſome obſervations on green crops; truſting, that if I gain not a prize, I ſhall at leaſt, upon the faith of the ſociety, be ſecure from contempt, or ridicule.

Under green crops, I ſhall conſider turnips, potatoes, beans, and clover; and ſhall offer ſome remarks upon the choice of the ground, for the crops intended to be cultivated; on the preparation of it before ſowing; and on the culture required for each of them afterwards. There are other green crops, as Saint-foin, lucerne, carrots, &c. but, as I have no experience in them, I ſhall not pretend to ſpeak on a ſubject of which I am totally ignorant. I ſhall not, for the ſake of ſcribbling, go into a field of ſpeculation, where I might talk of theoretical improvements and

imaginary

imaginary profits, without being certain of reducing them to practice; but ſhall confine myſelf entirely to what has fallen within the ſphere of my own obſervation or experience, though, I believe, ſome of thoſe which I propoſe paſſing over in ſilence are well worthy of our attention; in particular, I eſteem carrots an excellent ſpecies of green crop, and likely to prove equally beneficial for horſes as turnips are for cattle; but, as I know little of the method of rearing them, I ſhall only obſerve here, that I hope ſoon to ſee them introduced, as a part of the huſbandry of this country.

Before we enter upon this ſpecies of cultivation, we ought firſt to conſider what green crops are beſt adapted to our ſoil; for, ſhould we pretend to raiſe beans upon light, weak, or ſandy lands, and turnips upon ſtrong clays, we ſhould go egregiouſly wrong, and conſequently incur the diſappointment we deſerve; and, ſhould this be our firſt attempt in that ſyſtem of huſbandry, we might be induced to give it up in a pet. Whereas, had the beans been put upon the clays, and the turnips upon the light grounds, both might have ſucceeded, and encouraged us to perſevere in a mode of cropping ſo beneficial and advantageous. I would not be underſtood to aſſert, that turnips cannot be raiſed on clay lands. I have ſeen weighty crops of turnips upon clays, after a favourable

favourable ſpring for getting the ground well wrought, and properly pulverized, before ſowing, when followed by a dry warm ſummer. But it muſt be allowed, that in ſuch ſituations they are much more precarious than upon light ſoils: firſt, on account of the difficulty of getting a ſufficiently fine mould in the ſpring. Secondly, if the ſummer ſhould prove cold and wet, the plants, while young and tender, are apt to be chilled by the retentive quality of clay, which keeps the water much longer than light lands. Laſtly, ſuppoſing the crop to ſucceed, the field muſt be greatly injured by driving the turnips from it, in a wet winter, ſometimes more than the value of the beſt crop. Thus, though the turnips ſhould prove very valuable, they may be bought too dear.

Nothing is more hurtful to clay grounds, than poaching in wet weather. It moſt effectually diminiſhes the paſture of the plants, which every judicious farmer would wiſh to enlarge, by plowing and harrowing the clay fields, in dry weather only, and by the proper application of manures; which operations we may ſuppoſe completed before the turnips are ſown. Is it not therefore a pity, after a field (naturally heavy) has been put into a fine tilth by repeated ploughings, and ſtill more after the paſture of plants has been enlarged by the fermentation raiſed in the ſoil, in conſequence of the more ſubſtantial improvement

of

of dung or other manures, that it ſhould be entirely ſpoiled by the poaching of carts and horſes, in a wet ſeaſon? It is, by theſe means, wrought almoſt like maſon's mortar; and hence, for at leaſt one ſucceeding crop, every thing that had been done muſt be fruſtrated. After it becomes dry, the ſoil becomes ſo hard and conſolidated, that the tender roots of the plants find it impervious, and are unable to penetrate it, to procure food for their reſpective ſtems. For, it is obvious, that the greater number of roots a plant ſends forth, and the farther they extend, the better the ſaid plant will be ſupplied with food, and of courſe the more vigorous and luxuriant it will be.

It is, however, a hardſhip, that a perſon poſſeſſing a farm entirely of clay, ſhould be deprived of ſo beneficial a ſpecies of green food, for his cows and young calves, as turnips. I ſhall, therefore, endeavour to point out a plan by which a few may be obtained for that purpoſe, without much injury to his fields. This may be done by driving the turnips home in the dry weather of autumn, cutting away the roots and leaves, and ſtacking them. The leaves muſt be given to the cattle immediately, as they will not keep; but the turnips themſelves will keep good, until the months of March or April. The mode of ſtacking is, to put a ſheaf of thatch upon the

outſide,

outſide, building the turnips upon its interior end, while the other is allowed to ſlope downwards, to carry off the rain, and keep out the froſt. The ſtraw being thus put upon the outſide, will prevent the turnips alſo from rolling down: they may be thus built to a certain height, and drawn to a roof, like a ſquare ſtack of hay. The ſtraw muſt always hang down a little, to carry off the water. In ſome places the leaves are uſed, inſtead of ſtraw. I have ſeen them kept in good order till April; and they may be reſorted to, when the field is unfit for being carted upon. A few may be got from the field in froſty weather, when the carts can do no hurt; but this can be done on a ſmall ſcale only, for keeping a few cows, or calves, in good condition, and ought not to be extended for the purpoſe of feeding.

From what hath been obſerved, it may appear, that a perſon occupying clay land muſt not follow the ſame mode of farming that is practiſed upon a light free ſoil. I ſhall therefore take notice of the different rotations practiſed with ſucceſs, by the moſt eminent in our profeſſion, upon the three following ſoils, *viz.* firſt, the ſtrong rich clay; ſecondly, the deep free loam; thirdly, the light, weak, and gravelly ſoils.

The ſtrong clay cannot be well managed without ſummer fallow; after which, firſt, Wheat;

 ſecondly,

ſecondly, Beans; thirdly, Barley; fourthly, Clover; laſtly, Oats. In the free loam, naked fallow is unneceſſary, as it may be kept clean, and in good order, by the following rotation; firſt, Turnips, or Potatoes; ſecondly, Barley; thirdly, Clover; fourthly, Oats; fifthly, Beans; and laſtly, Wheat. The light or gravelly land muſt have a more gentle rotation; *viz.* firſt, Turnips; ſecondly, Oats, or Barley; thirdly, Clover; fourthly, Oats, and Turnips, as before, &c.

By theſe rotations, we have a green and white crop alternately; which has a good effect, and keeps the ground always in fine tilth. Mr. Tull is confident that all plants live upon the ſame food, and thence concludes a change of crops totally unneceſſary; but experience has now fully confuted this doctrine; for we find, that the more our crops are diverſified, the better they ſucceed. He alſo alleges, that the crop next the ſummer fallow is invariably the beſt; and that the ſucceeding ones are always, in an exact gradation, worſe and worſe. Were we to uſe nothing but white crops, his doctrine might be admiſſible; but, in the above plan, we generally find the oats, after clover, the moſt luxuriant of any in the whole rotation; though they are the fartheſt from the dung and the ſummer-fallow. This may poſſibly be owing to the roots of the clover affording a fine, eaſily-digeſted, and nouriſhing food

for

for the young oat-plants. But it is above my abilities to give learned or philoſophical reaſons, why one ſyſtem of cropping ſhould improve barren ground, ſo as to render it more fertile; or why, by continuing another kind of plants, the ſame ground ſhould be again reduced to its original ſterility. It belongs to philoſophers, and men of ſcience, to inveſtigate the abſtruſe cauſes of theſe effects. The humble farmer muſt content himſelf with obſerving that there are ſuch things as meliorating crops, and with practiſing what experience has found to ſucceed: though I confeſs, that when we can ſubject all our operations to "the teſt of rational principles," ſo as to underſtand the reaſons of our doing this or that, we ſhall go through them with the greater alacrity and chearfulneſs.

Having thus propoſed the modes of cropping upon the different ſoils, as practiſed by the beſt farmers, I ſhall ſay a little upon the preparation neceſſary before the ſowing of theſe different crops. I ſhall begin with ſummer-fallow; the principal intention of which is, to expoſe the ſoil to the influences of the atmoſphere, and to deſtroy weeds. All plants that ſpring up, except thoſe intended by the farmer, are denominated weeds: they are divided into two kinds, *viz.* weeds growing by the root, and annuals that are propagated by the ſeed only. A field has,

in general, both kinds to infeſt it, yet either the one or the other will be the principal nuiſances, and will chiefly predominate. As they require a different method to deſtroy them, the farmer muſt take his meaſures accordingly.

The way to deſtroy root-weeds is, to plough the ground frequently in dry weather, without making it too ſuddenly fine; for the rougher the ſurface is, the more readily the drought will be admitted. By every ploughing, the roots are removed from their place; and, when the ground is dry, they do not readily ſtrike root again. But, the ſureſt method is, when the ground is ſufficiently dried, to reduce it with breaks and harrows, which will empty the clods of their contents of couch-graſs, knot-graſs, &c. When this is properly executed, the roots ſhould be gathered and removed from the field. Some people diſapprove of breaking the clods, in preparing for wheat; as they think them of ſervice for that crop, in aſſiſting it to ſtand the winter, and the inclement blaſts of the ſpring; and would almoſt as ſoon have their heads broken, as a clod of the ſame ſize. If the clods be clean, and free from weeds, let them by all means be ſpared; if not, they ſhould be reduced; for couch-graſs, knot-graſs, and dock-weeds, though they make no appearance in the large clods, in dry weather, are not then dead, but in a dormant ſtate, and will con-

tinue

tinue in that ſtate, in clods of ten or twelve inches diameter, throughout the drieſt ſummer; and will revive as ſoon as the moiſture returns. Though theſe ſhould not prove very prejudicial to the wheat crop, they will be ſeverely felt during the ſubſequent crops of the rotation, but more eſpecially during the green ones. It is therefore ſometimes neceſſary even to roll clay lands, when foul, again and again, in order to reduce the large clods, if we wiſh to deſtroy the root-weeds effectually.

Weeds that are propagated by the ſeed, require a different treatment, and are beſt deſtroyed by retaining the moiſture, and by rendering the mould as fine as poſſible. The young plants will ſoon make their appearance. Theſe are to be ploughed down, and the ground again harrowed. Another freſh crop will come up, and be deſtroyed as before. By theſe means, the ſoil will be greatly exhauſted of the ſeeds that infeſt it; for, if a freſh crop come up every ploughing, and none of them are allowed to propagate their ſeed, they muſt always be growing thinner and thinner.

The doctrine of equivocal generation, of either plants or animals, is now univerſally exploded by philoſophers. It is to be wiſhed it were equally ſo with the farmers: but, while many of them would as ſoon believe Ovid's ſtory, that the plant-

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ing of viper's teeth produced a crop of armed men, as that organized plants ſhould ſpring ſpontaneouſly from the ground, without ſeed or root, there are others who would as ſoon renounce their creed, as refuſe their aſſent to ſuch ridiculous abſurdities: with ſuch principles their practice is too apt to correſpond; for, while they believe that weeds come up in this accidental manner, and that a particular ſoil will always produce certain kinds of weeds, we can ſcarcely ſuppoſe, that they will be ſufficiently induſtrious in uſing the proper means to extirpate them.

After the field is properly ſummer-fallowed, it ſhould be dunged and ſeed-furrowed about the end of Auguſt, or the beginning of September; and, about the firſt of October, ſown with wheat, at the rate of four buſhels to a Scotch acre. It will be much the better for lying two or three weeks in the ſeed-furrow, before it is ſown: this gives an opportunity for another crop of ſeeds to vegetate, to which the dung will contribute not a little. When the wheat is ſown, the weeds that would have infeſted the crop, had it been ſooner ſown, will be torn up by the harrows. Beſides, when any ſort of grain is ſown too ſoon after the plough, the ground is too open and porous. I ſuppoſe, in this caſe, the young plants are often hurt by puſhing their roots into too wide interſtices,

ſtices, and, from this cauſe, are ſometimes *in vacuo*, without touching the ſoil. But, from whatever cauſe it proceeds, it is remedied by allowing a little time for the ſoil to conſolidate; which proves that lands may be too looſe, as well as too compact.

When wheat and other white crops are ſown, they need nothing more till they are ready for cutting, unleſs a few thiſtles make their appearance, which ought always to be taken out, not only for the hurt they do to the preſent crop, but to prevent them from running to ſeed. For the ſeeds of thiſtles mount on their "downy pi-"nions," and are often carried miles by the winds before they alight; ſo that every one who allows them to flower and carry ſeed, not only riſks the ſpoiling of his own fields, but alſo thoſe around; which makes him a bad neighbour.

TO BE CONTINUED IN OUR NEXT.

IX. *On the Art of cleaning Woollen and other Cloths.* *By M.* CHAPTAL.

FROM THE *BULLETIN DES SCIENCES.*

THE art of cleaning cloths ſuppoſes, firſt, a knowledge of the various ſubſtances which can occaſion ſpots upon them. Secondly. That of the ſubſtances to which we muſt have recourſe in order to remove thoſe ſubſtances, when depoſited upon the cloth. Thirdly. That of the manner in which the colours of the cloths will be affected, by the re-agents meant to be employed for the removal of the ſpots. Fourthly. That of the manner in which the cloth itſelf will be affected by the above re-agents. Fifthly. We ſhould know how to reſtore the colour of the cloth, when it is changed or rendered faint.

Of the ſubſtances which occaſion ſpots upon cloths, ſome are eaſily known by their appearance; for inſtance, greaſe of every kind. Others produce more complicated effects, ſuch are, acids, alkalies, perſpiration, fruits, urine.

The effects of acids upon blacks, purples, blues, (except thoſe produced by indigo or by Pruſſian

Pruſſian blue,) and ſome other colours, and upon all thoſe ſhades of colour which are produced by means of iron, archil, and aſtringent ſubſtances, is to turn them red. They render yellows more pale, except that produced by arnatto, which they turn to an orange colour.

Alkalies turn ſcarlet, and all reds produced by brazil or logwood, to a violet colour; they turn green (upon woollen cloths) to yellow; and they give a reddiſh caſt to the yellow produced by arnatto.

The effect of perſpiration is the ſame as that of alkalies.

Spots which are produced upon cloths by ſimple ſubſtances are eaſily removed by well-known means.

Greaſy ſubſtances are removed by alkalies, by ſoap, by yolk of egg, or by fat earths. Oxides of iron, by nitric or oxalic acid. Spots occaſioned by acids are removed by alkalies, and *vice verſa*.

Spots cauſed by fruit, upon white cloth, are removed by ſulphureous acid, or, what is ſtill better, by oxygenated muriatic acid.

But, when the ſpots are of a complicated nature, various means muſt be employed, ſucceſſively; thus, to remove a ſpot occaſioned by the coom of carriage-wheels, we muſt firſt diſſolve the alkali by ſome of the means above mentioned, and

and then take away the oxide of iron by oxalic acid.

The colours of the cloths are often injured by the re-agents made uſe of; in order to reſtore them, we muſt thoroughly underſtand the art of dying, and know how to modify the means according to circumſtances. This is ſometimes difficult, becauſe it is neceſſary to produce a colour ſimilar to that of the reſt of the cloth, and to apply that colour to a particular part only; ſometimes alſo, the mordant which fixed the colour, or the baſis which heightened it, has alſo been deſtroyed, and muſt be reſtored. It is evident that, in this caſe, the means to be employed depend upon the nature of the colour, and that of the ingredients which produced it; for it is well known that the ſame colour may be obtained from very different ſubſtances.

Thus, when after having made uſe of an alkali, to remove an acid ſpot upon brown, violet, or blue cloth, &c. there remains a yellow ſpot, the original colour is again produced by means of a ſolution of tin. A ſolution of the ſulphate of iron reſtores the colour to thoſe brown cloths which have been dyed with galls. Acids give to yellow cloths, which have been rendered dull or brown by alkalies, their original brightneſs. When black cloths, dyed with logwood, have any reddiſh ſpots occaſioned by acids, alkalies turn ſuch ſpots

ſpots to a yellow colour, and a little of the aſtringent principle makes them black again. A ſolution of one part of indigo in four parts of ſulphuric acid, properly diluted with water, may be ſucceſsfully employed to reſtore a faded blue colour upon wool or cotton. Red or ſcarlet colours may be reſtored by means of cochineal, and a ſolution of muriate of tin, &c.

The choice of re-agents is not a matter of indifference; vegetable acids are generally preferable to mineral ones. The ſulphureous acid, however, may be uſed for ſpots from fruit: it does not injure blue upon ſilk, or the colours produced by aſtringents; nor does it affect yellow upon cotton. The volatile alkali ſucceeds better than fixed alkalies in removing ſpots produced by acids: it is uſually made uſe of in the form of vapour, and acts quickly, ſeldom injuring the colour of the cloth.

The means of removing ſpots of greaſe are well known; namely, alkalies, fullers earth, eſſential oils diſſolved in alcohol, a ſufficient degree of heat to render the greaſe volatile, &c.

Spots of ink, or any other occaſioned by yellow oxide of iron, may be removed by oxalic acid: the colour may be reſtored by alkalies, or by a ſolution of muriate of tin. Such ſpots may alſo be taken away by oxygenated muriatic acid, when they are upon white cloth, or upon paper.

The effect of alkalies and that of perspiration is the same; their spots may be removed by acids, or even by a dilute solution of muriate of tin.

When the spots are owing to various unknown causes, we must have recourse to compositions possessing various powers; of which the following may be considered as one of the most efficacious. Dissolve some white soap in alcohol; mix with this solution four or five yolks of eggs; add gradually some spirit of turpentine, and then stir into the mixture such a quantity of fullers earth as will enable it to be formed into balls. The manner of using these balls, is to rub the spots, previously wetted with water, with them; after which, the cloth is to be well rubbed and washed. By these means, all kinds of spots, except those occasioned by ink, or any other solution of iron, will be removed.

The washing of the cloth takes off its gloss, and leaves a dull spot, disagreeable to the eye. The gloss may be restored by passing, in a proper direction, over the washed part of the cloth, a brush wetted with water in which a small quantity of gum is dissolved, and then laying upon the part a sheet of paper, a piece of cloth, and a pretty considerable weight, which are to remain there until the cloth is quite dry.

X. *Experiments and Obſervations on the Glutinous Part of Wheat. By M.* Tessier.

FROM THE *MEMOIRES DE L'INSTITUT NATIONAL.*

Of the conſtituent parts of wheat, that which appears to have moſt excited the attention of philoſophers, is the glutinous part, known alſo by the name of *vegeto-animal matter.*

Having been employed in examining the various ſpecies and varieties of this plant, and being deſirous to know every particularity concerning them, it was ſcarcely poſſible that I ſhould not ſeek to diſcover how much vegeto-animal matter each of them was capable of furniſhing; and whether any circumſtance contributed to increaſe its proportion.

I ſhould have carried my enquiries upon this ſubject (as well as upon many others) to a much greater extent, if ſome particular circumſtances had not ſtopped my progreſs. I can therefore offer only a few reſults; but, trifling and imperfect as they are, they will not be totally uſeleſs, if they ſhould engage any other perſon to purſue the ſubject, and to fulfil, better than I have been able to do, the end I had in view.

After

After the harveft of 1791, I caufed to be ground twenty forts (fpecies and varieties) of wheat; fome of them were hard, the others foft. They were gathered from the fame foil, which was of an inferior quality. A fufficient quantity of each fort was ground; and fuch precautions were taken, as to prevent the poffibility of a miftake refpecting the flour produced from each particular kind of wheat.

I fhall not at prefent fpeak either of the proportion of flour produced from thefe different wheats, or of the various kinds of bread I obtained from them; thofe will furnifh matter for another memoir: in this, I fhall confine myfelf to what concerns the glutinous part.

One pound of each fort of flour was made into a thick pafte, and afterwards worked for a long time with the hands, (according to the ufual manner,) under a very thin ftream of water, which ran, or rather dropped upon it; by this means, all the ftarch was feparated from the glutinous part. The latter I weighed while wet, and then dried it gently upon the cover of a faucepan, filled with boiling water, and placed over the fire.

The refult of thefe operations was, firft, that two of the fore-mentioned kinds of wheat, one of which had fmooth ears of a reddifh colour, with diverging beards, and grains of the ufual yellow colour,

colour, and which ripened very early, and another kind which had white ears, alſo ſmooth, without beards, with grains of a white colour, and which came originally from Philadelphia, gave each of them five ounces of glutinous matter from a pound of wheat; whereas, another kind, which had ſmooth reddiſh ears, growing cloſe together, with beards, and which ſeemed to be a variety of that called *Bled de Miracles*, and another kind which had white ears, with ſtraight beards, and long glumes, with hard long grains, and which is particularly diſtinguiſhed by the name of Poliſh wheat, (*Triticum Polonicum, Linnæi*,) gave only, the firſt, two ounces, and the ſecond, two ounces and a half, of this ſubſtance, *per* pound. From another kind, with purpliſh ears, bearded, and pubeſcent, with hard ſpotted grains, and which came originally from Nice and the Canaries, I obtained only half an ounce of the above matter *per* pound. The other ſorts, produced from four ounces to four ounces and a half *per* pound.

Secondly, that the flour of hard-grained wheats produced, in general, leſs glutinous matter than that of ſoft ones.

Thirdly, that the glutinous part of ſome kinds, after being dried, was more brittle than that of others; this was particularly the caſe with the hard-grained wheats.

Fourthly,

Fourthly, that, according to the remarks of M. Parmentier, in his work upon the vegetables uſed for food, the glutinous part loſes much of its weight by being dried *.

Laſtly, that the loſs of weight is in the inverſe ratio of the quantity obtained.

The object of this memoir is merely a comparison of the quantities of glutinous matter fur-

* Our colleague, M. Parmentier, expoſed ſome of the glutinous matter, divided into ſmall pieces, to a very gentle evaporation, till it could be reduced into powder. He found that it loſt three-fourths of its weight; and that the beſt grain contained only an eighth part. This aſſertion is not exaggerated; for, after having collected the glutinous part of different kinds of wheat, and deprived them as much as poſſible of their ſtarch, and of their water, and dried them thoroughly, I found, at the end of four years, a decreaſe of weight, amounting to two-thirds, to three-fourths, to four-fifths, and even to ſeven-eighths, according to the ſpecies or variety of wheat made uſe of; and I very ſeldom obtained more than two ounces, in a ſtate of dryneſs, from a pound of wheat. It muſt be obſerved, however, that the weight of the glutinous part cannot be compared with that of flour in its uſual ſtate; becauſe a pound of flour, which did not appear to be wet, being put to dry gradually upon a warm ſtove, was, in the ſpace of four and twenty hours, reduced to fourteen ounces; that is to ſay, it loſt one-eighth part, without appearing burnt, or ſuffering any alteration in its colour. From which it follows, that in order to eſtimate truly the loſs of weight in the glutinous part of a pound of flour, it muſt be extracted from a pound of flour which has already been dried, or elſe be conſidered as the produce of only fourteen ounces of flour.

niſhed

niſhed by the different kinds of wheat; it is conſequently indifferent in what ſtate they are eſtimated, and alſo what proportion they bear to the weight of the flour. It is ſufficient for me to have ſhown, that the flour of twenty different ſorts of wheat, after being treated in the ſame manner, furniſhed a quantity of vegeto-animal matter which, whether it was weighed immediately after its extraction, or not until it was completely dried, was in very different proportions.

This comparative trial having informed me of a circumſtance I wiſhed to know, I proceeded to the inveſtigation of another. It appeared to me important to determine, whether manures of any kind could contribute to the formation of the glutinous part, and, if ſo, what thoſe manures were. With this view, in the ſpring of the year 1792, I prepared, in a piece of land the ſoil of which appeared to me all of the ſame nature, nine beds, each containing two perches, of twenty-two ſquare feet; they were exactly ſimilar in every reſpect, excepting in the manure made uſe of to them.

In one of theſe beds, I folded a flock of ſheep and goats, amounting in the whole to one hundred and forty; they remained on the bed about two hours; and the reſult of the folding appeared to me to be ſuch as commonly takes place from

 that

that operation in the departments of Seine-et-Oiſe, Seine-et-Marne, Loiret, and Eure-et-Loir.

Another bed was manured with two ſacks of horſe-dung, in a rather rotten ſtate.

The third, with two ſacks of cow-dung, in the ſame ſtate.

The fourth, with ſixty-four quarts of human urine.

The fifth, with thirty-ſix quarts of bullock's blood.

The ſixth, with the remains of plants, reduced into the ſtate of mould.

The ſeventh, with three buſhels of pigeon's dung.

The eighth, with human excrement in powder, prepared at Mont-faucon.

The ninth was not manured at all.

I ſowed every one of theſe beds with the ſame kind of wheat; namely, that kind which has ſmooth white ears, without beards, the grain of the uſual colour, the ſtraw hollow, and which is uſually ſown in the month of March.

Although a compariſon of the quantity of grain produced was not the principal object I had in view, yet I think it right to obſerve, that the bed manured with pigeon's dung was that which produced the greateſt quantity of grain. After that, I gathered the greateſt quantity from the two beds manured with human excrement, and with

with human urine. Next to thefe, the greateft quantity was produced from thofe manured with bullock's blood, and with horfe-dung. The beds manured with the remains of plants, and with cow-dung, were lefs productive. That which had no manure at all, produced little more than double the quantity which was fown; whereas the others produced more than fix times the quantity fown.

With refpect to the quantity of glutinous matter, which was the principal object in view, the refult of the experiment was as follows. The wheat of the bed watered with urine, produced fix ounces of glutinous part from a pound of flour, not dried. That of the bed in which the fheep and goats were folded, and that of thofe manured with horfe-dung, with cow-dung, with pigeon's dung, with bullock's blood, with the remains of plants, alfo that to which no manure was ufed, gave five ounces of glutinous part *per* pound. Laftly, that which was manured with human excrement, gave only four ounces *per* pound.

It will, undoubtedly, be difficult to conceive, why the eight manured beds above mentioned did not give an equal proportion of vegeto-animal matter; for the wheat was all produced from the fame feed, was fown in land which was the fame in appearance, and the manure was applied in the ufual manner. It is evident that the manure was not the caufe of this difference; becaufe,

from the wheat which grew in the bed not manured, I procured five ounces of glutinous matter *per* pound; that is, a quantity equal to that procured from the wheat of ſix other beds manured in various ways; a circumſtance which naturally leads us to ſeek elſewhere for the cauſe of the variation in the proportion of glutinous matter.

I ſhall here obſerve, that the wheat made uſe of for the above experiments in ſpring, was the ſame as one of thoſe on which I made the firſt-mentioned experiments in the autumn of 1791; and that, in the experiments of 1791, it produced only three ounces of glutinous matter *per* pound, inſtead of five or ſix. This would lead us to ſuppoſe, that wheat ſown in March contains more glutinous matter than that ſown in autumn; or at leaſt that the latter, notwithſtanding its longer vegetation, does not contain a greater proportion of it.

As a brief recapitulation of the preceding reſults, I ſhall ſtate, that different ſpecies and varieties of wheat produce various proportions of the glutinous part, which is more or leſs brittle, and which, before it is dried, ſometimes amounts to more than a third part of the flour; but, when dried, does not commonly exceed one-eighth. Manures do not appear to contribute to the formation of this ſingular ſubſtance.

Many

Many intereſting circumſtances reſpecting this ſubſtance ſtill remain unknown; for, it may reaſonably be enquired, firſt, whether it is proved that no other grain contains this glutinous part. It has, without doubt, been aſcertained, that it cannot be obtained from rye, from barley, or from oats; but, have experiments been made upon the flour produced from the ſeeds of other kinds of graſſes? Is it not probable, for inſtance, that it would be found in the grain of what is called manna-graſs, ſo much uſed in Poland?

Secondly. Rural œconomy would require that we ſhould examine, whether the wheats of one diſtrict always contain more glutinous part than thoſe of another; this examination would neceſſarily take up ſeveral years.

Thirdly. We ſhould alſo determine whether the expoſition of the land, and the nature of the ſoil, ought to be admitted among the cauſes which contribute to the formation of the glutinous part *. For this purpoſe, it appears neceſſary that

* M. Parmentier, in the work already quoted, ſays that there are ſome kinds of wheat, particularly thoſe which grow in wet places, or in poor ſoils, whoſe product of glutinous matter ſcarcely amounts to one ounce *per* pound; and that, on the contrary, there are others which contain near two ounces. I ſhall not contradict this aſſertion, for the fact is certain; I ſhall only obſerve, that if by poor ſoils M. Par-

that we ſhould form an artificial ſoil, of which the ingredients were well known; a difficult taſk, and one which can only be undertaken by a zealous perſon, who reſides in the country.

Fourthly. Suppoſing that theſe enquiries ſhould produce merely negative proofs, and that only a concurrent or ſecondary cauſe ſhould be diſcovered, it will then remain to be known, why, of the various grains which ſerve us for nouriſhment, wheat is the only one that appears to contain this vegeto-animal matter, or at leaſt that contains ſo much of it. We muſt not be too ſanguine in expecting to diſcover this laſt truth; becauſe it may depend upon the particular organization of the vegetable, which organization we cannot inveſtigate. But, it will be a great deal to have diſcovered in what conſiſts, or upon what depends, in the various ſpecies or varieties of wheat, the greater or leſs quantity of this glutinous matter, which is of ſo much conſequence in the proceſs of making bread.

M. Parmentier means dry and ſtony ones, it appears to me more natural to ſuppoſe, that as the wheat which grows in ſuch ſoils is of good quality, it ſhould contain a greater quantity of glutinous part. This, however, requires to be more carefully examined.

XI.

XI. *List of Patents for Inventions, &c.*

(Continued from Vol. XI. Page 432.)

ANTHONY GEORGE ECKHARDT, of Queen's Buildings, Knightsbridge, Gentleman, F. R. S.; for a method of constructing and moving the back and bottom of fire-grates, combined with cheeks, on a new construction, which is particularly adapted for kitchen-ranges, and can be applied to other grates; by which a great saving of coals will be obtained. Dated October 3, 1799.

JOSEPH SMITH, of the parish of St. Martin in the Fields, in the county of Middlesex, Gentleman; for improvements in the internal bracings of piano-fortes, so as to admit the introduction of a drum, tambour, or tambourine, with sticks or beaters thereunto belonging. Dated October 3, 1799.

JOHN HOTCHKIS, Esquire, Lieutenant in the Royal Navy; for a mechanical power, for the purpose of lifting weights, moving ships, weighing anchors, &c. Dated October 3, 1799.

JAMES BELL, of Chancery-lane, in the county of Middlesex, Taylor; for a pocket fastening, to prevent the loss of property. Dated November 4, 1799.

THOMAS

Thomas Foden, of the city of Coventry, Woollen-manufacturer; for a cryſtalline ſize or mixture, to be uſed in ſizing and dreſſing cotton, worſted, and linen yarn. Dated November 4, 1799.

William Lonsdale, of Harrington, in the county of Cumberland, Mariner; for an improvement in weighing anchors, ſteering ſhips, and other advantageous methods of weighing, raiſing, and uplifting any heavy burthen or weight, on board of ſhips. Dated November 4, 1799.

Richard Hall Gower, of Leadenhall-ſtreet, in the city of London, Mariner in the ſervice of the Eaſt India Company; for a method of rigging veſſels upon an improved plan. Dated November 4, 1799.

Ralph Gout, of Bunhill-row, in the pariſh of St. Luke, Old-ſtreet, in the county of Middleſex, Watch-maker; for improvements on pedometers and pedometrical watches, for the purpoſe of aſcertaining more accurately, and with greater preciſion, the number of ſteps the wearer makes in walking; and, when affixed to a ſaddle, the number of paces the horſe makes; and alſo, when affixed to a curricle or other carriage, the number of revolutions of the wheel. Dated November 4, 1799.

Printed by John Nichols, Red-Lion-Paſſage, Fleet-Street, London.

REPERTORY OF ARTS AND MANUFACTURES.

NUMBER LXVIII.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

XII. *Specification of the Patent granted to Mr.* THOMAS CROSBEY, *of the City of Bath, in the County of Somerſet, Vintner; for a moveable regulating Machine or Apparatus, for the Improvement of Fire-places and Flues.*

Dated January 12, 1795.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that in compliance with the ſaid proviſo, I the ſaid Thomas Croſbey do hereby declare, that the nature of my ſaid invention, and the

the manner in which the ſame is to be performed, is particularly deſcribed and aſcertained in manner and form following; that is to ſay: The machine or invention is made either of wrought iron, caſt iron, copper, braſs, tin, or other metal, or of earth or clay burnt, ſtone, lime, or any other hard, compact, and fit ſubſtance or ſubſtances whatever, and of ſuch breadth to fit the back part of any chimney or flue, in which the ſame is to be fixed or placed; having, in front of the machine or invention, a valve or cover, of ſuch ſize and dimenſions as the chimney or flue in which the ſame is to be fixed, to lift up and down at pleaſure, by means of a handle or ſcrew fixed to the ſame for that purpoſe. The ſame, when down, will prevent all ſudden guſts or blaſts of wind driving the ſmoke and duſt into the room, and, at the ſame time, it conſiderably increaſes the draught for the ſmoke to aſcend, by preventing all other communication with the upper part of the chimney or flue, but through the machine or invention, or the falſe back to be left behind the ſame, as is hereinafter mentioned and deſcribed. On the other hand, when the valve is raiſed, the draught decreaſes, according to the height that it is raiſed; by which means, the draught or current of air in the flue is either leſſened or increaſed at pleaſure. At the

top

top of the valve, and fixed to the front of the first plate, and which constitute the first draughts or cavities for the smoke to ascend through, when the valve or cover is let down, are two small tubes or pipes, to permit the smoke to ascend through, in order to create a greater draught; the size of which depends, in a great measure, upon the size or dimensions of the chimney or flue, in which the said machine or invention is to be fixed; it being necessary for them to be larger in a kitchen chimney or flue than in a parlour; which said pipes or tubes are not connected with the back draughts or cavities. The first plate, against which the above-mentioned tubes or pipes are fixed, and which constitutes the front of the first draught or cavity, when the valve is down, is made with many small holes, to draw all dust and ashes into the strong draught behind, which carries the same up the flues, by force of the velocity of air and smoke passing through the machine or invention, thereby preventing the dust and ashes from flying about the room, which they otherwise would. The second plate or partition, which makes the back of the first draught or cavity, and the front of the second draught or cavity, when the valve is let down for the smoke to ascend through, is likewise made with holes, either round, oblong, square, or otherwise, of a

larger ſize than thoſe in the firſt plate or partition, which admit the duſt and aſhes, and likewiſe the ſmoke and air, more freely, and in a greater degree, into the back draught, vent, or cavity, which will be made by placing the machine or invention againſt the chimney or flue, leaving a cavity or hollow at the back part thereof, in the ſolid ſtone, brick, or other materials with which the chimney, fire-place, or flue is made, and placing againſt the ſame a tin or other plate; the heat of the fire, acting upon the ſame, creates a greater heat in the flue or cavity, which rarefies the air and ſmoke in a greater degree than if the back of the chimney, fire-place, or flue, was left without placing a plate of tin or other metal againſt the ſame; which ſaid back flue, vent, or cavity, has a communication above the fire-place, to receive the duſt and aſhes that fly from the top of the fire; and alſo receives the light duſt and aſhes that fly from the bottom of the fire, when ſtirred or moved, by means of the back flue or cavity being continued down in the ſolid ſtone or brick work with which the fire-place is made below the grate; which flue, cavity, or vent, creates ſuch a ſtrong draught below the fire, that all light duſt and aſhes are drawn up the ſame. All which flues, vents, cavities, tubes or pipes,

in the ſaid machine or invention, are not ſo wide at the top as at the bottom, thereby increaſing the velocity of the air and ſmoke paſſing through the ſaid invention, the air being rarefied by the fire beneath, ſo as to accelerate and impel the aſcenſion thereof with great rapidity; and the ſides of the ſaid machine or invention are made ſolid and compact, ſo as not to admit or emit any air through the ſame. Which ſaid invention is to be fixed or placed of ſuch height in the chimney or flue as creates the ſtrongeſt draught; and the ſame can eaſily, and at very ſmall expence, be removed from one chimney or flue to another, without doing any injury to the chimney or flue from which the ſame is taken or removed. In witneſs whereof, &c.

XIII. *Specification of the Patent granted to Mr.* William Whittington, *of Sheffield, in the County of York, Wheelwright; for his Invention of a portable baking Stove.*

WITH A PLATE.

Dated June 28, 1796.

To all to whom theſe preſents ſhall come, &c. Now know ye, that in compliance with the ſaid proviſo, I the ſaid William Whittington do hereby declare, that my ſaid invention of a portable baking ſtove is deſcribed in the plan and deſcription thereof, hereunto annexed. In witneſs whereof, &c.

This portable baking ſtove is calculated for the ſeveral different purpoſes of baking all kinds of bread, eſpecially oat-bread, which it performs with a facility and cheapneſs hitherto unknown, as it does not require one-fifth part of the fuel uſed in the common way, and may be heated with coals, coke, wood, charcoal, or any other kind

kind of fuel; or may be heated from any other fire, at any proper diſtance required. It may be uſed in houſes, gardens, fields, camps, on board of veſſels of every deſcription, at ſea, or upon rivers, or elſewhere, being portable, and immediately moveable to any ſituation, and made ready to operate in a few minutes. It may be manufactured of caſt iron, wrought iron, copper, tin, or any other kind of mixed or malleable metal whatſoever, or of any kind of clay, ſtone, or compoſition. It may be made to any ſize, either in length, breadth, or depth required; or made to any ſhape, as ſquare, oblong, circular, ſemi-circular, oval, ſpherical, or any other regular or irregular figure whatſoever. It may be made either with or without an oven, heating ſtove, cooking ſtove, or any other kind of ſtove. The door for ſupplying the fuel, and the pipe or flue for conveying away the ſmoke, may be fixed in any part of the ſtove.

The annexed drawing (ſee Plate IV.) is a repreſentation of the ſtove.

A, is the door for ſupplying the fuel.

B, is the pipe or flue for drawing the heat, and conveying away the ſmoke.

C, is a grit or ſand ſtone, or any other proper ſtone or plate, for the firſt operation of baking bread

bread or cakes of any deſcription, eſpecially oat bread or cakes.

D, is a plate for ſoaking the bread, and finiſhes the operation.

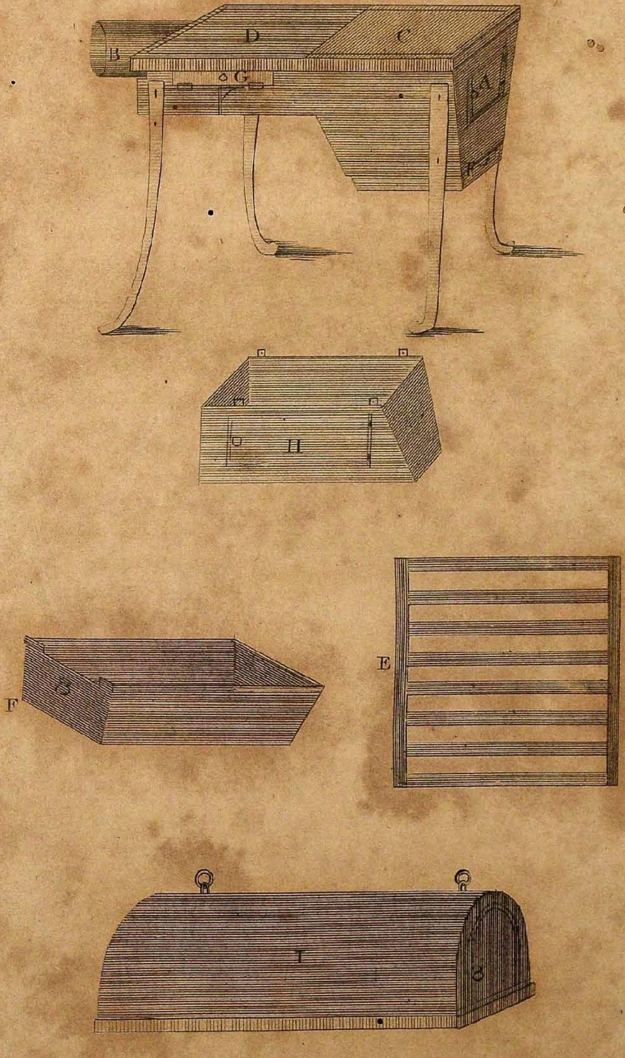
E, is the grate at the bottom of the ſtove, to admit external air; under which, a box or drawer, F, may be placed to receive the aſhes. The ſame fire, conſiſting of a very ſmall quantity of fuel, will heat all parts of the ſtove.

G, is the oven-door, that is made in the ſtove.

H, is a looſe box or oven, to be ſcrewed or rivetted to the under-ſide of the ſtove, to fit the level part of the ſtove.

I, is a looſe top or cover, to cloſe in the heat.

In frugality and utility it exceeds any thing hitherto invented, or made uſe of.


D
C
B
G
A
H
E
F
I

XIV. *Specification of the Patent granted to* Joseph Huddart, *of Islington, in the County of Middlesex, Esquire; for an improved Method of registering or forming the Strands in the Machinery for manufacturing of Cordage.*

WITH A PLATE.

Dated August 20, 1799.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Joseph Huddart do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say:

My method (for which I have already obtained his Majesty's letters patent) of registering or forming the strands of cordage, in order to acquire an additional degree of strength, by giving the length of the yarns which compose the strand a certain ratio, according to the angle and hardness or compression the rope is intended to be laid with, and thereby acquiring a more equal distribution

 of

of the ſtrain upon the yarns than ropes made in the common way, conſiſts of the following principles. Firſt. By keeping the yarns ſeparate from each other, and drawing them from bobbins, which revolve, to keep up the twiſt whilſt the ſtrand is forming. Secondly. By paſſing through a regiſter, which divides them by circular ſhells of holes; the number in each ſhell being agreeable to the diſtance from the centre of the ſtrand, and angle the yarns make with a line parallel to it, and gives them a proper poſition to enter. Thirdly. A cylindrical tube, which compreſſes the ſtrand, and maintains a cylindrical figure to its ſurface. Fourthly. By a gauge, to determine the angle which the yarns in the outſide ſhell make with a line parallel to the centre of the ſtrand, when regiſtering; and, according to the angle made by the yarns in this ſhell, the length of all the yarns in the ſtrand will be determined. Laſtly. By hardening up the ſtrand, and thereby increaſing the angle in the outſide ſhell, which compenſates for the ſtretching of the yarns, and compreſſion of the ſtrand. If theſe principles are duly attended to, every yarn in the ſtrand will bear a ſtrain when at the point of breaking; and, when laid into a rope, it will acquire additional ſtrength. For a deſcription of theſe principles, and the method of performing them, (of which

I am

I am the firſt inventor,) I refer to the ſpecification of the patent granted me, and dated the twenty-fifth of April, 1793, and ſhall now proceed to deſcribe my farther improvement, (for which the letters patent above recited are granted,) which conſiſts in the invention of a machine that may be worked by men, or any other power, and by means of which the regiſtering may be carried on more commodiouſly. It is illuſtrated by the accompanying drawing, (ſee Plate V.) Figs. 1 and 2, which have the ſame letters of reference. The regiſter and tube, Fig. 1, muſt, inſtead of being drawn along the yarns, be fixed at any convenient diſtance from the bobbins. The machine, the frame of which may be of wood, or iron, revolves round its axis, upon the gudgeons at A and B; that gudgeon next the regiſter, at A, (being perforated to receive the ſtrand from the regiſter-tube *x*, deſcribed in my former patent,) works in the centre of a fixed or ſun wheel A, which, by the machine revolving, gives motion to the planet wheel C, Figs. 1 and 2, in the machine, and the bevel pinion upon its axis D, which carries the bevel wheel E, and upon its axis the ſpur wheel F. This wheel F carries the wheel G, and upon its axis the wheel P, and the whirl H, which has a groove, to receive the ſtrand from the perforated gudgeon; and, after

paſſing about two-thirds round this whirl, to wind in like manner upon the whirl I, of the ſame diameter, connected by equal wheels P and Q, upon their axes, to give equal motion to the whirls; ſo that the friction of the ſtrand in the grooves of the whirls may not ſuffer it to ſlide over them, (or the ſtrand may wind over more whirls, to increaſe the friction if neceſſary,) in its paſſing to the reel K, which has a motion communicated to it by a band paſſing round L, a whirl upon the axis of a crank applied to one end of the reel, and M, a whirl upon the axis of one of the former whirls I. This band muſt be ſufficiently tight to give the reel a power to prevent the ſtrand from ſliding round the whirls H and I, which it paſſes over, and yet ſo eaſy as to allow itſelf to ſlide round the whirls L or M, when the reel, by the increaſe of its diameter, from the ſtrand being wound upon it, would draw more than the whirls H and I give, which are to regulate the quantity or length of ſtrand, and for the adjuſtment of which, a clip that moves upon the centre N, with friction wheels *o*, *o*, is provided, to be tightened by a ſcrew, pins, or otherwiſe, (which, to prevent confuſion, is not repreſented in the drawing,) to draw the legs N *o*, N *o*, nearer together. In order to vary the angle or degree of twiſt, and form ſtrands of dif-

ferent

ferent ſizes, by the ſame machine, the wheels F and G, which work in each other, are provided in pairs, (the ſum of the two radii of each pair being equal,) which vary in numbers, one or more teeth in each wheel, and may be extended to as great a variety as neceſſary, by ſhifting thoſe pairs, and applying them to either axis. This difference in number will increaſe or diminiſh the ratio between the revolutions of the machine and that of the whirls, which determines the length of ſtrand to be drawn each revolution. Now the length of one turn and the circumference of the ſtrand being given, which forms a right-angled triangle, the triangle is given, and therefore the angle of regiſtering found, which may be compared with the regiſter-gauge; or the ratio may be varied, by different ſets of the whirls H and I applied to their axis, each ſet of different diameters from another ſet. Or, if the groove in the whirls is ſo formed that the width of the outer part *k k*, Fig. 3, is equal to the diameter of the largeſt ſtrand intended to be regiſtered on the machine, and the ſides of the groove by right lines, meeting at the axis or centre of the whirl at *l*, the machine will regiſter all ſtrands at the ſame angle, when the ſame ſhifting wheels are applied. The ſmaller ſtrand *m*, paſſing round that part of the whirl, at the diſtance

tance *l m* from the centre, will draw a leſs length of ſtrand, in the ſame ratio to the circumference as the larger ſtrand *n* to its diſtance from the centre *n l* and circumference; therefore, the angles of regiſtering will be equal in various-ſized ſtrands regiſtered by the machine. It is neceſſary to have a traverſe, to paſs the ſtrand more regularly round the reel, and particularly to aſcertain the turns, and fraction of a turn, if any, that the ſtrand makes in winding from one end of the reel to the other, in order to acquire the length of ſtrand regiſtered. This may be performed various ways now in practice, by communicating the motion from the axis of the crank which carries the reel, by worms, or tooth and pinion, to a heart and lever, or otherwiſe, to guide the ſtrand over. But my invention is by the application of a cylinder R, which makes half a revolution while the ſtrand is winding from one end to the other of the reel; and by a ſpiral ridge or groove upon its ſurface, which moves the lever *a b* upon the cylinder, by friction wheels, or pin, at the under ſide of the lever, or otherwiſe, the ſtrand paſſing between the rollers *x* and *y*, at the end of the lever, and returns the ſtrand again to the end of the reel, where it begun, while the cylinder moves through the other half of its revolution, which is communicated

municated by wheels and pinions, from the axis of the crank or reel, to the cylinder. In this drawing, Figs. 1 and 2, where *c* reprefents the wheel upon the axis of the lever, and carries *d*, with the pinion *e*; and the pinion *e* carries the wheel *f*, and pinion *g*; which carries the wheel *h*, and pinion *i*. This pinion *i* carries the wheel *k*, fixed upon the axis of the cylinder R, which, by two pins in it, may give motion to an index, to fhew the number of fhells of ftrand wound upon the reel, and afcertain the length of the ftrand. The wheels *c* and *d*, or any other pair, may be made to fhift, and vary the revolutions of the cylinder, according to the fize of the ftrand, as before defcribed; and, having regiftered the required length upon this reel, it may be fhifted, by drawing the pin S, which is fecured by a forelock, or otherwife. The ftrands are then to be run upon the laying-ground, and hardened up by the hooks to the required angle, as defcribed in my former patent, and then topped or laid into a rope in the common way. I muft remark, that the tube *x* of the regifter, inftead of being in two parts, to comprefs the ftrand, may be of folid metal, without much injury to the performance; as, from the compref-fibility of the ftrand, and the evennefs of fize, when compofed of many yarns, it will pafs the tube

tube very uniformly; and alſo, if the ſtrands are ſmaller than the hole in the perforated gudgeon at A, which will generally be the caſe, it will be neceſſary to have friction wheels between the machine and the tube *x*, to confine the ſtrand in the axis of the tube continued, to prevent any vibratory motion in the ſtrand, which will render a long tube unneceſſary, as the ratio of the yarns is given at the mouth on firſt entering the tube, and its length is only to preſerve the direction of the ſtrand. The fore board of the regiſter, in Fig. 1, may be diſpenſed with, if the yarns from the bobbins come to the regiſter at a ſufficient diſtance to keep them from being entangled by the fibres, which it was intended to prevent; and, if a ſufficient number of turns is put in the yarns before winding, there will not be any neceſſity for keeping up the twiſt in regiſtering, if performed by this machine, when the diſtance is ſhort between the bobbins and regiſter. The bobbins may be run either perpendicularly or horizontally; and the machine may alſo revolve with its axis parallel or perpendicular to the horizon, as the ſituation may require. In witneſs whereof, &c.

XV.

Fig. 1.

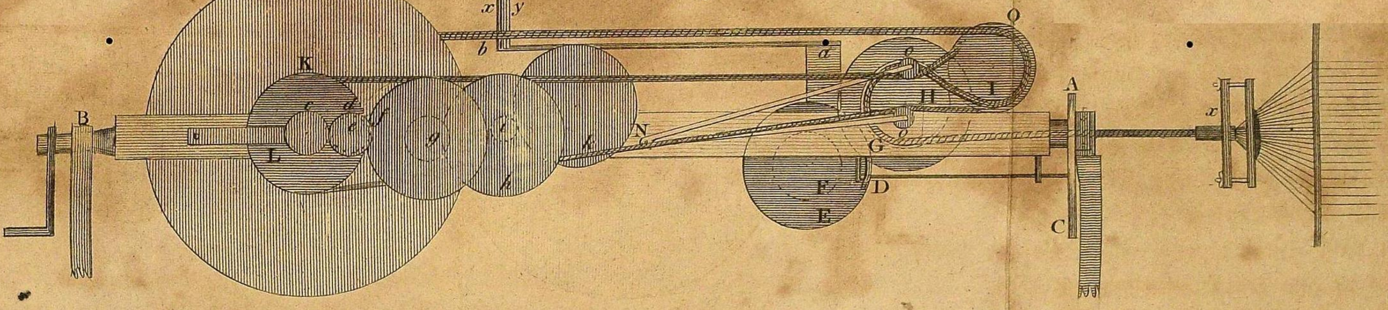


Fig. 2.

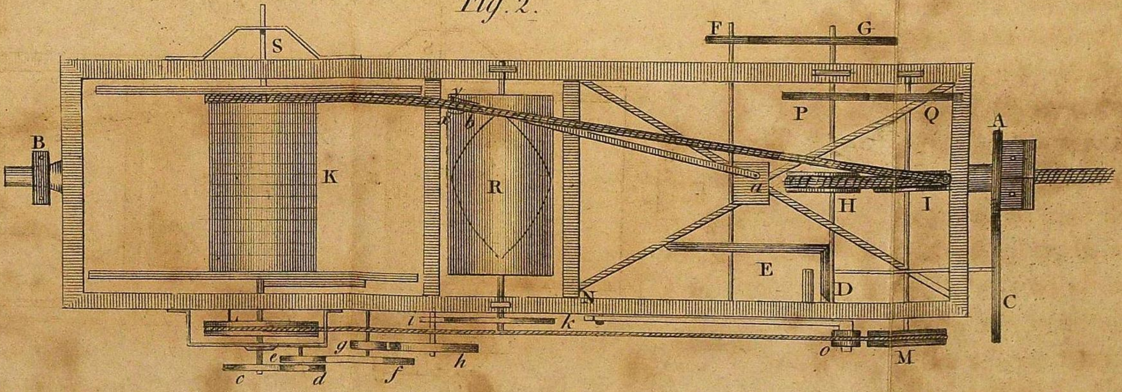
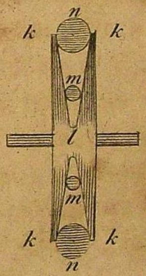


Fig. 3.



XV. *Specification of the Patent granted to Mr.* JOHN WILLIAMS *and Mr.* JOSEPH WILLIAMS, *of Holywell-ſtreet, in the Pariſh of St. Clement Danes, in the City and Liberty of Weſtminſter, Stationers; for an improved Method of binding all Sorts of Books.*

Dated Nov. 4, 1799.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that in compliance with the ſaid proviſo, we the ſaid John Williams and Joſeph Williams do hereby declare, that our ſaid invention conſiſts of a back, of a ſemi-circular, ſemi-oval, or any other ſemi or curved form, turned a little at the edges, made of iron, ſteel, copper, braſs, tin, or any other metal, ivory, bone, wood, vellum, paper, leather, or any other material capable of retaining a firm ſituation; which back, being put on the book before bound, in that manner ſo as juſt to cover over (but not to preſs) the edges of the paper, will, when the book is opened, prevent it ſpreading on either ſide,

 and

and caufe it to rife in any part to nearly a level furface. If neceffary, (though by no means effential,) the vacuity from the firm back to the angle of the paper may be hid by a cap at each end, made of the aforefaid or any other material, with a fpring-catch, to faften within the back; for which purpofe, the back muft be fufficiently large to admit the cap, fo as to prevent the paper being fretted againft; and tin, or fome other matter, placed over the catches.

The above firm back, turned at the edges, to caufe freedom in opening all forts of books, is for which this patent is obtained. The method we ufe in binding books is as follows: the paper forwarded in the ufual manner, fewed on vellum flips, glued, cut, clothed, and boarded, (or half boarded,) and the firm back put on, by being faftened at the fides, through holes, by vellum, or fecured by inclofing it in vellum or forrel wrappers, or other matter, pafted down upon, or drawn through, the boards, and the other half the board pafted over, the cover put on, and book finifhed. In witnefs whereof, &c.

XVI.

XVI. *On different Sorts of Lime used in Agriculture.* *By* SMITHSON TENNANT, *Esq. F.R.S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

I WAS informed last summer, that in the neighbourhood of Doncaster two kinds of lime were employed in agriculture, which were supposed to differ materially in their effects. One of these, which was procured near the town, it was necessary to use sparingly, and to spread very evenly over the land; for it was said that a large proportion of it, instead of increasing, diminished the fertility of the soil; and that, wherever a heap of it was left in one spot, all vegetation was prevented for many years. Fifty or sixty bushels upon an acre, were considered to be as much as could be used with advantage. The other sort of lime, which was obtained from a village near Ferry-bridge, though considerably dearer, from the distant carriage, was more frequently employed, on account of its superior utility. A large quantity was never found to be injurious; and

and the ſpots which were entirely covered with it, inſtead of being rendered barren, became remarkably fertile. The different properties aſcribed to theſe two kinds of lime were ſo very diſtinct, that it ſeemed probable they could not be imaginary; and it therefore appeared to be worth the trouble of aſcertaining them more fully, and of attempting to diſcover the nature of the ingredients from whence the difference aroſe. For this purpoſe, I procured ſome pieces of each ſort of limeſtone, and firſt tried what would be their effect upon vegetables, in their natural ſtate, by reducing them to coarſe powder, and ſowing in them the ſeeds of different plants. In both kinds, the ſeeds grew equally well, and nearly in the ſame manner as they would in ſand, or any other ſubſtance which affords no nouriſhment to vegetables. Pieces of each ſort of ſtone were then burnt to lime; and, after they had been expoſed for ſome weeks to the air, that their cauſticity might be diminiſhed, ſome ſeeds were ſown in them. In the kind of lime which was found moſt beneficial to land, almoſt all the ſeeds came up, and continued to grow, as long as they were ſupplied with water; and the roots of the plants had many fibres, which had penetrated to the bottom of the cup in which they grew. Upon examining the compoſition of this ſort of lime, it proved to conſiſt entirely of calcareous earth. By

its

its expoſure to the air for about three months, it was found to have abſorbed four-fifths of the fixed air required to ſaturate it. In the other kind, a few only of the ſeeds grew, and the plants produced from them had hardly any ſtalks or roots, being formed almoſt entirely of the two ſeed-leaves, which lay quite looſe upon the ſurface. This ſort of lime, being ſpread upon a garden ſoil, to the thickneſs of about the tenth of an inch, prevented nearly all the ſeeds which had been ſown from coming up; whilſt no injury was occaſioned by common lime, uſed in the ſame manner. Upon examining the compoſition of this ſubſtance, which was ſo deſtructive to the plants, it was diſcovered to contain three parts of pure calcareous earth, and two of magneſia. The quantity of fixed air which it had abſorbed, by being expoſed for about the ſame time as the pure lime juſt mentioned, was only 42 hundredths of that combined with it before it was burnt.

As it ſeemed probable, that the magneſia contained in this lime was the cauſe of its peculiar properties, the following experiments were made, to determine the effects of that ſubſtance upon the growth of vegetables. Some ſeeds, chiefly of colewort, which were preferred from their growing quickly, were ſown in uncalcined magneſia; but, though they ſprouted, the leaves ne-

ver

ver rose above the surface, and the plants were entirely without roots: nor did they appear to grow better in magnesia which had been washed in water containing fixed air. Calcined magnesia was, however, much more destructive, as the seeds would not come up in it. To compare its effects on vegetables with those of lime, each of these earths was mixed, in different proportions, with sand, in small cups, in which, seeds were then sown. The lime was obtained from marble; and, before it was put into the sand, was made to fall to powder, by being moistened with water. In a mixture of four ounces of sand with three or four grains of calcined magnesia, it was a long time before the seeds came up, and the plants had hardly any roots or stalks; and, with ten grains or more of magnesia, there was no appearance of vegetation. Thirty or forty grains of lime did not retard the growth of the seeds more than three or four of magnesia, and the injurious effects were not so lasting. The lime, by absorbing fixed air, soon lost its destructive properties; so that, after keeping these mixtures four or five weeks, seeds were found to grow in that with forty grains of lime, nearly as well as in pure sand; but, in that with four grains of magnesia, they produced only the seed leaves, as was described before. It was necessary occasionally to break in pieces the sand which had so much

lime,

lime, as it would otherwise have been too hard to admit the seeds to penetrate through it. Plants will bear a much larger proportion of magnesia in vegetable soil than in sand: with twenty grains, however, of calcined magnesia, in as much soil as was equal in bulk to four ounces of sand, the seeds produced only the seed-leaves, without roots; and, with about forty grains, they were entirely prevented from coming up.

In countries where the magnesian lime is employed, it was said, that the barrenness of any spot on which a heap of it had been laid, would continue for many years. To learn how far it could by time be deprived of its injurious qualities, I procured some pieces of mortar made of this species of lime, from two houses, one of which had been built three, and the other eight years: they were taken from the outside of the building, where they had been exposed to the air. After they were reduced to powder, seeds were sown in them. Only a few came up, and even those produced merely the seed-leaves, without any roots. As plants would grow in the limestone from which this species of lime was formed, although not in the mortar made from it, I wished to know what proportion of the fixed air originally contained in the limestone, had been absorbed by the mortar. For this purpose, a piece of it was finely powdered, to render it of an uni-

form

form quality; it was then tried how much of this powder and of the limeſtone would ſaturate the ſame quantity of acid: by this means, I aſcertained the proportions of limeſtone and mortar containing equal quantities of the magneſian lime. The fixed air being obtained from them in thoſe proportions, and meaſured in an inverted veſſel, with quickſilver, it was found, that the mortar which had been expoſed three years had abſorbed 43, and that of eight years only 47 hundredths of the quantity originally contained in the limeſtone. I was not able to obtain any mortar which had been made earlier, though it might deſerve to be known how much fixed air it was ultimately capable of abſorbing. Common mortar, which had been expoſed to the air for a year and three quarters, had regained 63 hundredths of its full quantity of fixed air.

As the preceding experiments were tried during the winter, in a room warmed by fire, perhaps, under circumſtances more favourable to vegetation, the ſame quantity of magneſia would not be equally pernicious.

Magneſian limeſtone may be eaſily diſtinguiſhed from that which is purely calcareous, by the ſlowneſs of its ſolution in acids, which is ſo conſiderable, that even the ſofteſt kind of the former is much longer in diſſolving than marble. From this property of the magneſian limeſtone, there

there appeared to be reason for suspecting that the kind of marble which had been called Dolomite, from M. Dolomieu, who first remarked its peculiarity in dissolving slowly, might also be similar in its composition. An analysis of this substance was lately given in the *Journal de Physique*, but this is probably erroneous; for, upon examining three specimens, they were found to consist of magnesia and calcareous earth, like the magnesian limestone; so that it ought, no doubt, to be considered as the same species of stone, but in a state of greater purity. The pieces of Dolomite were from different places; one of them being found among the ruins of Rome, where it is thought to have come from Greece, as many statues of Grecian workmanship are made of it, and no quarries of a similar kind are known in Italy; the second was said to have been thrown up by Mount Vesuvius; and the third was from Iona, one of the western islands of Scotland. In many kinds of common marble, small particles and veins may be observed, which are a long time in dissolving. These, upon examination, I discovered to contain a considerable proportion of magnesia; but, as they were probably not quite free from the surrounding marble, I did not ascertain the quantity precisely.

The cryſtallized ſtructure which may generally be obſerved in the magneſian limeſtone, ſeems to ſhew that it has not been formed by the accidental union of the two earths, but muſt have reſulted from their chemical combination. The difficulty of diſſolving it, may alſo ariſe from the attraction of the different component parts to each other. The mortar formed from this kind of lime, is as ſoluble in acids as common marble; and the ſubſtances of which it conſiſts are eaſily ſeparated. The magneſia may be taken from it by boiling it in muriated lime; and lime is precipitated by it from lime-water; but neither of theſe effects can be produced by the ſtone, before it is calcined.

Magneſian limeſtone is probably very abundant in various parts of England. It appears to extend for thirty or forty miles, from a little ſouth-weſt of Workſop, in Nottinghamſhire, to near Ferry-bridge, in Yorkſhire. About five or ſix miles farther north there is a quarry of it, near Sherburn; but, whether this is a continuation from the ſtratum near Ferry-bridge, I have not learnt. From ſome ſpecimens which were ſent me, I find that the cathedral and walls of York are made of it. I have not been able to learn whether there were any ſhells in the limeſtone of the tract of country before mentioned.

In

In Mr. Marſhall's account of the agriculture of the midland counties, he ſpeaks of the lime made at Breedon, near Derby, as deſtructive to vegetables, when uſed in large quantities. I therefore procured ſome pieces of it, and they were diſcovered to contain nearly the ſame proportion of magneſia as that before deſcribed. In this quarry, the ſtone is frequently cryſtallized in a rhomboidal form; and petrified ſhells, not calcareous, but ſimilar in compoſition to the ſtone itſelf, are ſometimes, but very rarely, found in it. This ſubſtance ſeems to be common in Northumberland. In the third volume of the Annals of Agriculture, Dr. Fenwick, of Newcaſtle, obſerves, that the farmers of that country divide limes into hot and mild. The former of theſe is no doubt magneſian, as it has ſimilar effects on the ſoil; and he remarks, that it is not ſo eaſily diſſolved in acids as the latter. At Matlock, in Derbyſhire, the two kinds are contiguous to each other; the rocks on the ſide of the river where the houſes are built being magneſian, and on the other, calcareous. The magneſian rock appears alſo to be incumbent upon a calcareous ſtratum; for, in deſcending a cave formed in this rock, a diſtinct vein of common limeſtone may be obſerved, which contains no magneſia. The latter ſtratum is very full of ſhells; but, though there

are ſome alſo in the magneſian rock, yet they are very rare. In the following tables, containing the analyſis of various ſpecimens, ſome other places are mentioned where this ſubſtance is found, but of which I received no farther information.

After it was known that the magneſian marble and limeſtone conſiſted of the two earths, their proportion was attempted to be diſcovered, by trying how much gypſum and Epſom ſalt could be obtained, by means of vitriolic acid, from a certain weight of each ſpecimen. When the ſuperfluous vitriolic acid had been evaporated by heat, the Epſom ſalt was ſeparated from the gypſum, by water. The reſult of theſe trials is expreſſed in the following table.

	Dry gypſum.	Dry Epſom ſalt.
5 grains of limeſtone from Breedon gave	3.9	3.15
——————— Matlock	3.95	2.9
——————— Workſop	3.8	3.0
——————— York	3.8	3.1
3 grains of calcareous ſpar and 1 grain of calcined magneſia gave	3.9	2.7

As the preceding method of eſtimating the quantities of magneſia and calcareous earth is liable

liable to considerable error, I afterwards examined them in the following manner, which seems capable of great exactness. Twenty-five grains of each substance were dissolved by marine acid, in a cup of platina, and, after the solution was evaporated to dryness, it was made red-hot for a few minutes. The mass remaining in the cup, which consisted of muriated lime, and of the magnesia freed from the acid, was washed out with water, and poured into a phial. There was then added to it a known quantity of diluted marine acid, somewhat more than was sufficient to redissolve the magnesia, and, after the solution, a certain weight of calcareous spar, part of which would be dissolved by the superfluous acid. By the quantity of spar remaining undissolved, it was learnt how much acid was required to dissolve the magnesia. The iron and argillaceous earth contained in some specimens, were precipitated by the spar, and therefore could not occasion any error. The calcareous spar, however, dissolved more slowly where there was argillaceous earth, as it became coated with it; but this incrustation was occasionally removed, and, in all the experiments, the spar was left in the solution till it suffered no farther diminution. For this purpose, it was necessary to keep them slightly warm for some days, during which time, the phials were generally

generally closed, to prevent any escape of the acid.

The first experiment in the following table was made upon known quantities of magnesia and calcareous earth, to try the accuracy of the process. For this purpose, also, the second was repeated upon a piece of limestone, previously powdered, to render every part of it of the same quality. The first column shews the quantity of calcareous spar which might have been dissolved by the acid required to take up the magnesia. The second shews the corresponding quantities of magnesia in 25 grains of each substance. The third expresses the quantity of lime. This was inferred by subtracting the weight of the magnesia, and of the iron and clay, from 13.2 grains, the weight of the whole quantity of earth in 25 grains of limestone. This is probably not very incorrect, as, in two specimens which differed most in the proportion of magnesia and lime, the weight of the two earths was nearly the same.

A piece of Dolomite from Rome was wrapped in a thin leaf of platina, that no part of it might be lost, and, being then exposed to a strong heat, left of earth - 52.9 *per cent.*

Dolomite from Mount Vesuvius - - -	52.8
Breedon limestone - -	52.4
Calcareous spar left of lime	55.8

In

In three of the experiments, alſo, the calcareous earth was precipitated by mineral alkali; and, the quantity of it being tried by that of the marine acid required to diſſolve it, it correſponded very nearly with that put down.

A quantity of marine acid which would diſſolve 15 grains of calcareous ſpar, would alſo diſſolve 5.5 of calcined magneſia, and 2.5 grains of ſpar; ſo that, 12.5 grains of ſpar required the ſame quantity of acid as 5.5 grains of magneſia.

The magneſia uſed was very pure, and made red-hot immediately before it was weighed.

Subſtances examined.	Quantity of ſpar which the acid, required to take up the magneſia, would have diſſolved.	Quantity of magneſia.	Quantity of lime.	Iron and clay.
Mixture of 5.5 grains of magneſia and 14 grains of calcareous ſpar .	12.5	5.5	7.8	0
25 grains of Breedon limeſtone, previouſly powdered . . .	11.53	5.071	7.929	.2
25 grains from part of the ſame powder .	11.56	5.082	7.913	.2
25 grains of Dolomite from Rome . . .	12.2	5.37	7.73	.1
——— Dolomite from Iona . . .	10.1	4.4	7.8	1.0 {Inſoluble ſubſtance.
——— Veſuvian Dolomite	10.38	4,565	8.575	.06
A ſecond experiment, from part of the ſame Veſuvian Dolomite .	10.03	4.411	8.849	.06
25 grs. of magneſian limeſtone from Wanſworth, near Doncaſter . .	12.75	5.61	7.34	.25
——— Thorpe arch .	10.95	4.84	7.8	.6
——— Matlock . .	12.5	5.5	7.388	.31
——— York minſter	11.	4.84	8.26	.1
——— Workſop . .	11.6	5.104	7.496	.6
——— Sherburn . .	11.5	5.08	7.56	.56
——— Weſtminſter hall	10.1	4.44	8.37	.4

XVII. *Defcription of a Machine for counterbalancing the Ropes ufed in the deep Shafts of Mines. By Mr.* WILLIAM FEATHERSTONHAUGH, *of Chefter-le-ftreet, Durham.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal of the Society was voted to Mr. FEATHERSTONHAUGH, for this Invention.

THE beginning of laft year I conftructed a model of a counterbalance, for preferving a conftant equilibrium between the ropes ufed in machinery wrought by fteam-engines, or otherwife, for the purpofe of raifing coals, upon a plan which I had never feen or heard of before, which I fhewed to the proprietors of fome extenfive coal mines in this neighbourhood, who immediately got a large one conftructed, which they continue to ufe, and prefer to any of the other counterbalances erected in this county.

The beſt mode that I have ſeen adopted may be thus deſcribed. A chain is faſtened to the axis of the rope-barrel, which, paſſing over a pulley, deſcends into a pit, and is there faſtened to the end of a very heavy chain. When the ropes are in equilibrio, the large chain is at the bottom of the pit; but, as the difference of their weights increaſes, the ſmall chain, winding upon the axis of the rope-barrel, lifts up the large one from the bottom of the pit, till it is ſuſpended at full length, at which time one corf has aſcended to the top of the ſhaft. One diſadvantage attending this counterbalance, is, the depth of the pit for the chain to deſcend into. I meaſured the depth, at a machine upon a colliery belonging to Sir Henry Tempeſt Vane, Bart. and found it to be fourteen fathoms, meaſured from the axis of the pulley to the bottom; the depth of the ſhaft being eighty-eight fathoms and a half. At Heaton colliery, near Newcaſtle-upon-Tyne, the owners thereof expended near two hundred pounds, in attempting to ſink a pit for the counterbalance chain, but which they could not get ſunk deeper than three fathoms and a half, on account of water; they therefore fixed the pulley five fathoms from the top of the pit, making the whole length of ſpace for the chain to move in, eight fathoms and a half. They have lined the pit near the bottom with metal plates, to prevent the

the chain wearing away the ſides: I think the chain muſt ſuffer much by friction.

The counterbalance which I erected is ſtill uſed at a coal-pit in Harraton colliery, ſituated about two miles from Cheſter-le-ſtreet, and belonging to the truſtees of the late William Henry Lambton, Eſq. The depth of the pit for the counterbalance is five fathoms, meaſured from the axis of the pulley to the bottom. The weight ſuſpended at the end of the chain is thirty-one hundred weight and a half; diameter of the wheel, fifteen feet and a half; depth of the ſhaft, ſeventy-ſix fathoms and a half; and weight of ſeventy-ſix fathoms and a half of rope, five hundred weight two quarters. Another diſadvantage attending the counterbalance firſt deſcribed is, that it does not regularly take off the weight of the heavier rope; which will appear by conſidering, that immediately after the corves have paſſed each other in the ſhaft, and the difference of the weights of the ropes is very ſmall, the leſſer chain is acting very powerfully upon the axis, which is of an equal diameter in each part whereon the chain winds. According to my plan, there is an irregularity occaſioned by the weight of the chain, but it is very trifling.

One inconvenience which may poſſibly attend the counterbalance I invented is, that as the engine-men, through inattention, ſometimes

draw a corf over the pulley above the ſhaft, the weight at the end of the chain may be drawn too high, and ſome part of the machinery may be broken; but, during a year and a quarter's conſtant uſe of this counterbalance, the engine-man, though he has ſometimes drawn a corf over the pulley, has always been able to ſtop the machine before any accident happened. It would conſiderably diminiſh the friction, to fix the large wheel nearly in a horizontal poſition, with bevel teeth, ſo that its weight might reſt almoſt entirely on one end of the axis.

The counterbalance formerly uſed at Harraton colliery is on the following conſtruction. A large wheel, with a weight fixed therein, near to its circumference, is placed directly above a pinion on the end of the rope-barrel: when the ropes in the ſhaft balance each other, the weight is at reſt; but, the machine being put in motion, the pinion turns the large wheel, and the weight aſcends till it has deſcribed a quadrant of a circle, at which time its power is the greateſt, and one rope has reached the top of the ſhaft. This counterbalance does not act uniformly, and its power is very ſmall.

There has been a counterbalance erected at Heaton colliery, about fourteen or fifteen weeks ago, by Mr. Jeffreys, an engineer, near Newcaſtle-upon-Tyne, on nearly the ſame con-

ſtruction

ſtruction as mine; the principal difference being, that in his the chain hangs directly from the wheel, and the weight moves in a gutter. Mr. Jeffreys ſays, he never had an opportunity of bringing it into uſe before; but was ſhewn a model of it above ſix years ago, by a perſon of the name of Crowther, who, I ſuppoſe, is employed under him. When I recommended the new counterbalance to be erected at Harraton, the proprietors were uſing the old one deſcribed above, having the large wheel directly over the pinion. They made the improvement without taking down the large wheel; and, on account of its being in rather a bad ſtate, they have not much more than one ton weight ſuſpended at the end of the chain.

References to the Figure.

(See Plate VI.)

F F F, are the different parts of the framing. A ſteam-engine is ſuppoſed to turn the barrel A, by means of a crank at the end D. E, is a fly wheel. R, R, are the ropes which deſcend into the mine. When the engine is put in motion, the barrel A revolves, and, by means of a pinion on the end of its axis, turns the wheel G: the chain C, with a weight W at the end,

end, winding upon one of the curves K, K, which are formed of pieces of timber, ſtrongly faſtened to the arms of the wheel G, and in which grooves are cut, to prevent the chain from ſlipping off: the teeth of the wheel and pinion are of caſt iron. A pit muſt be dug for the weight W to deſcend into, but it need only be of a very ſmall depth; whereas, in the beſt counterbalances which I have ſeen, a pit of conſiderable depth is neceſſary, in the ſinking of which, in ſome inſtances, when there has been much water, I have known a very large ſum expended. When the wheel G has revolved ſo far that the chain makes a right angle with the arm V, at the extremity thereof, it then acts with its greateſt power, and the difference of the weights of the ropes is the greateſt. The curves K, K, were attempted to be drawn of ſuch a form that, as the wheel G revolved, a perpendicular let fall from its centre upon the line of direction of the chain might uniformly increaſe; but, according to the method in which I have applied the chain, it could not be done perfectly exact. X, is a weight, to balance the curved pieces of timber on the oppoſite ſide of the wheel. Where there are ſeveral ſtrata of coal in one pit, if a counterbalance be calculated for the deepeſt, it will anſwer for the reſt, without alteration. Where the depth is very great, two counterbalances may eaſily be applied;

or

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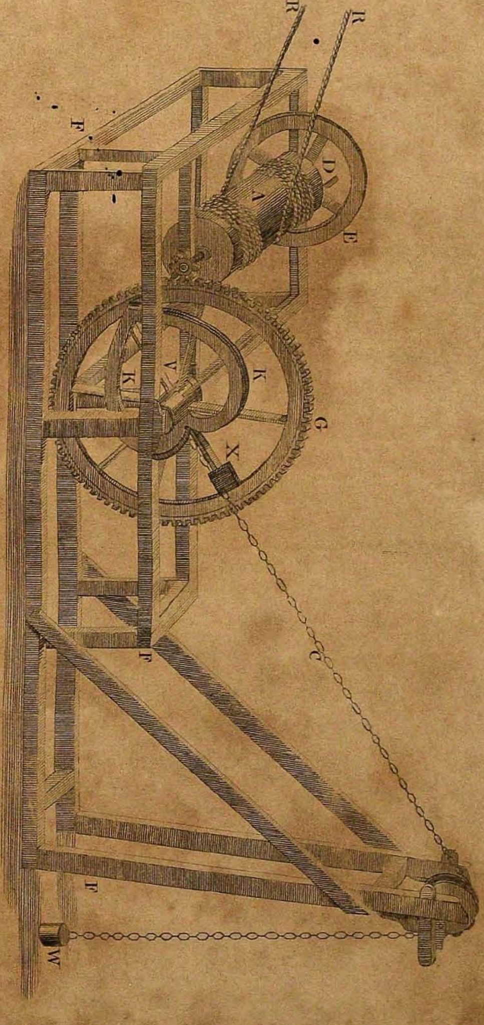


or the power of this counterbalance may be increased, by making the ſpiral-ſhaped pieces of timber extend beyond the circumference of the wheel.

Annexed to the above account is a certificate, ſigned T. Croudace and M. Featherſtonhaugh, managers of ſeveral collieries, and proprietors of the machinery erected thereon for the purpoſe of drawing coals, ſtating that they have uſed Mr. William Featherſtonhaugh's counterbalance about fifteen months, and think it is the beſt method that has ever been propoſed to them.

There is alſo another certificate, ſigned Jacob Weatherburn, Engine-wright, ſtating that he conſtructed the counterbalance above mentioned; and that, on comparing the expence of ſuch a counterbalance with that of one by means of a large chain, for the depth of ſeventy-ſix fathoms and a half, he is of opinion that there will be little difference in the firſt coſt, except where there is much water, in which caſe, the latter method will be much more expenſive. Alſo, that the counterbalance here deſcribed may be upholden and replaced, at new pits, for leſs expence.

XVIII.

XVIII. *On the Cultivation of Potatoes from the Rind, &c. By the Rev.* Edward Whittle, *of Odstock, near Salisbury.*

From the Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture, &c.

PERHAPS, amongst all the various kinds of information, there may be times and seasons when that which is the most simple may be of the most general use, because it can be more easily and more effectually communicated, and carried into practice with greater facility.

Notwithstanding the considerate goodness of the Society, in informing the public of the cheapest method of raising potatoes, and recommending them at this time to plant more than usual, the growers of that useful root are, in general, so bigotted to their old method of doing things, that it is with the greatest difficulty they can be prevailed on to make improvements, although they would certainly tend to their own and the general good; and are rendered quite certain by experiments already tried. It is in consequence of

of conversation with men of this description, that I am induced to trouble you with this letter; men who would not be convinced to the contrary, but that the decaying potatoe afforded so much more nourishment to the green which sprung from it, than would possibly be afforded from a piece of rind, as would render the crop much more abundant; and affected to disbelieve what was inserted in the Salisbury Journal by your Society, because the persons' names who made the experiments were not inserted. However, having been in the habit of planting potatoes for these fifteen or sixteen years past, I have been induced to make the following experiments.

In the year 1790, I planted a large square of potatoes, one-third of which was with *the rind*; one-third with *whole potatoes*; and the other part with *pieces*, cut in the usual way; and I assure you, when the season came for digging, there was not the least visible difference in the produce.

The following year, I planted in the same row or drill, one whole potatoe, one piece, and one piece of rind, in which there was an eye, alternately; and, when the season came for digging, I was very careful in my observation, but unable to perceive any difference in the crop.

In the year 1793, when the servant was digging up my potatoes, besides those fit for eating, I discovered a great number about the size of a

 walnut,

walnut, and from that to a hazel nut, which I ordered to be left in the ground. In the spring of 1794, my two potatoe beds were irregularly covered with greens, which sprung from these small potatoes; I therefore prepared, about the middle of April, (for, on account of the coldness of the land, I have always had the best crops from potatoes planted at that time,) two other beds, about the same size, into which I transplanted these greens; about one-third of which had the seed hanging to them, and about two-thirds had not, having dropped off in drawing. With these I planted one bed and a half, and made up the other half bed partly with whole, and partly with potatoes cut in the common way, some in drills, and some planted in holes made with a setting-stick; and I have to state, that we were as exact as possible (without weighing or measuring) in our observations, and we could not discern the least difference in the production, the crop being, to all appearance, quite as good from the shoots as from the whole or the cut potatoe; and I am convinced there is not the least necessity for planting the potatoe, in order to raise a crop, as the rind, or shoots, will produce one equally as good. The reason which induced me to make out the remaining half bed with whole and cut potatoes, when I before was satisfied that the rind would answer the end, was, that

that if I had told my neighbours that the ſhoots produced as good a crop as the rind, and the rind as the ſhoots, they would have replied, "that is very probable, but if you had planted "whole, or cut potatoes, your crop would have "exceeded either!"

In a ſecond letter, Mr. Whittle writes as follows.

I have only to obſerve, that I continue, as uſual, to plant only the *parings* of potatoes, and the young ſhoots which occaſionally ſpring from the very ſmall ones, generally left in the ground as good for nothing, and which are ſeldom picked out, except for the purpoſe of cleaning the land. Sometimes I have planted them in drills, and ſometimes in holes made with a ſtick, covering them with muck; but, as to the manner of planting, I have never obſerved any difference in the crops. Laſt year, indeed, I was from home a conſiderable part of the year, and I find the potatoes were cut in pieces when planted; but I have found no advantage by it in the preſent crop, except what I expected from new ground.

When the potatoes are pared for planting, one or two eyes ſhould be carefully preſerved in every piece, and a ſmall portion of the potatoes, about the ſize of a horſe-bean, to every eye.

XIX. *Continuation of Mr.* BRODIE's *Obſervations on Green Crops.*

(From Page 55.)

AFTER the wheat is removed from the field, a furrow will be neceſſary, to prepare for beans; which muſt be ſown with another furrow, in the ſpring, as ſoon as the ſeaſon will permit. They are generally ſown with three ploughs following one another, running the bean-barrow behind one of them; which leaves three furrows betwixt every row of beans. This affords room for ploughing betwixt the rows, which, with hand-hoeing, it will be neceſſary to perform twice in the courſe of the ſeaſon: they are the better for being ſown thick, and require ſix buſhels to the acre.

The crop after beans is barley; which alſo ſhould have an autumn and a ſpring furrow, that the mould may be rendered very fine, for the reception of the graſs ſeeds, which are to be ſown with the barley: one buſhel of good rye-graſs, and twelve lbs. of broad clover-ſeed, to the

the acre; three firlots of barley, if very good, will be enough. If it is not the beſt, it will require nearly a boll to the Scotch acre.

After the barley is cut, cattle muſt be carefully kept from trampling upon the young graſs, both in autumn and winter. It will alſo ſometimes be of uſe to defend it from the crows; in particular, at the breaking of a ſtorm of ſnow, I have ſeen them very ſevere upon the young clover, eſpecially where it was a ſcarce commodity in the neighbourhood: they are, at theſe times, ſo much pinched for food that they will eat any thing. I have ſeen fine breards or ſhoots of clover diſappear, from this very cauſe, though it was attributed to the froſt throwing out or killing it. I have always obſerved it thinneſt where the crows flocked moſt upon it; and that it was leaſt hurt where they were ſcared by being near a public road, or village. Crows, of late years, are alſo very hurtful to turnips, by picking holes in their ſides; which, with froſts and rains, is often the cauſe of their rotting. It is a pity that this voracious bird is not as effectually extirpated from this country as wolves, and ſome other ravenous quadrupeds. Some people inſiſt that crows are uſeful in picking up worms, and other vermin, from the fields; but we ſee no difference upon the places from which they are ſcared, except for the better, as was above obſerved. As

I reckon

I reckon clover the beſt of all green crops; I would wiſh to guard it from every danger; I would therefore adviſe every one, when flocks of crows are ſeen ſettling upon young graſs, or turnips, to ſcare them with a few ſhots of gunpowder.

Having given the preference to clover, and accounted it the beſt green crop, it will perhaps be expected that I ſhould give reaſons for ſo bold an aſſertion. Firſt, it is found to thrive either in a warm or cold climate. Secondly, it ſucceeds upon either wet or dry grounds; on light lands, or ſtrong clays. Thirdly, its being introduced into every rotation where green crops are cultivated, is a ſtrong proof of its ſuperior qualities. In ſhort, it will thrive in every corn climate, and almoſt on every ſoil, if properly prepared. So much cannot be ſaid for any other green crop. Beans will not ſuit light ſandy lands, or late climates. Potatoes, and turnips, can never be ſucceſsfully cultivated upon wet ſoils. Clover requires no additional ploughings, or harrowings: all the other green crops require to be two or three times ploughed and harrowed. It is alſo a moſt excellent preparation for a crop of oats. It is got at no great expence; as the ſecond crop is generally ſuppoſed to work the firſt.

The making of hay is, in good weather, an eaſy proceſs. After cutting, one general rule is,

to

to preserve the natural juices, as much as possible, from being evaporated by sun or winds; but, above all things, to keep it from rain after it is dried. Newly-cut clover and rye-grass hay is so full of the natural sap that it will not admit water, and can bear a considerable quantity of rain without sustaining much injury; but, as soon as it is dry it becomes open and porous; admits water, like a sponge; and, before it can be sufficiently dry for keeping, the natural juices are almost totally exhaled along with the rain water: it will then lose its fine smell and flavour, and afford but a poor nourishment. It must, therefore, be put into small cocks at first, and into larger ones soon after; both being made narrow on the top, to prevent water from lodging; and, so soon as it will keep, it should be stacked, and covered with thatch: it will then be a most excellent food, either for black cattle or horses.

As I have been led, by beginning with plain fallow, into the clay-land rotation, I shall conclude it by observing, as already hinted, that the oats, though last, will not be least. In a former paragraph I imputed the luxuriance of clover oats, to the clover roots affording a proper nourishment to the young plants of the oats. I have rather been confirmed in this opinion, by an experiment made by Mr. George Bogue, of Broomrig, tenant at Bolton,

Bolton, an excellent and fortunate farmer, whofe veracity may be depended upon. He had an inclofure of young grafs, which he fubdivided with a paling; pafturing the one half, and cutting the other. Notwithftanding the whole dung and urine was, by thefe means, left upon the paftured half, what was cut for hay was confiderably the beft crop of oats; which I afcribe to the clover roots not growing fo large on the paftured half, by the plants being daily cropt throughout the fummer. Clover oats require only one furrow, in the months of January or February; and may be fown, when the weather is fuitable, in March. One boll of good oats will be fufficient to the acre: if they are foft, more will be needed.

Much has been faid, by effayifts on agriculture, about the effects of lime; whether it operates as a manure, or a ftimulus. It is above my reach to account for its way of operating; but this I will boldly aver, that a good liming, properly managed, will do good for ages, probably for ever: the ground will then have a degree of fertility which it had not in its unlimed ftate. Though lime does good to white crops for a few years, its effects are foon over, and it leaves the ground "poor indeed." Where green crops are properly intermixed with the white, its power will be more lafting: but, for the former it is parti-

culariy

cularly efficacious; and, where they ſucceed, the white will follow of courſe. Though every crop may be raiſed by the force of dung; yet, if a field has once got a ſufficient doſe of lime, a ſmaller quantity will anſwer the purpoſe: by theſe means, the dung will go farther, and the quantity, by better crops, will increaſe yearly. Indeed, before a man ſhould be ſanguine in raiſing green crops, he ought to learn whether his fields have been limed or not. If they have once had a proper quantity, it is not abſolutely neceſſary to repeat it, though a ſecond liming will ſtill do good; but, if they have had none at all, he ought to procure lime, or marl, for them, which will have a good effect upon his graſſes and green crops.

There are two ways of raiſing turnips; *viz.* by broad-caſt, and by drills. The laſt of theſe is greatly to be preferred. Firſt. The horſe-hoe and plough can both be introduced with ſucceſs; and thus the ground, by frequent ploughings, is expoſed to the influence of the air, as in fallow. Secondly. The weeds, by theſe ploughings, are made to vegetate, and deſtroyed as they come up. Thirdly. A ſmaller quantity of dung will ſerve a drilled than a broad-caſt crop; as it is laid below the turnips only. Fourthly. By the introduction of the plough and horſe-hoe, they are much ſooner cleaned by the hand-hoers, which

is a great object, as theſe are often very ſcarce. Laſtly. The weightieſt crops are commonly on drills. Nor is this to be wondered at, when we conſider, that by laying two furrows together, thus, a b c d ΛΛΛΛ, the ſoil is evidently doubled below the plants. a, b, c, d, are the tops of four drills, with the dung in the heart of them, which, with the double ſoil, muſt be highly advantageous. Beſides, the open furrows are ſo many drains for carrying away the ſuper-abundant moiſture, which is often hurtful to the broad-caſt crop in a wet ſeaſon.

The method of raiſing drilled turnips is, to plough the field intended as ſoon after harveſt as poſſible, in order to rot the ſtubble, and to expoſe the ſoil to the benefit of the air, and froſts, during winter, that a fine mould may be procured. As ſoon as the field is dry, in the ſpring, it ought to be ploughed, harrowed, and managed, in every reſpect, like ſummer fallow, (ſee page 51,) till about the end of May *, or beginning of June, when the drills may be laid up, as already explained. The dung, being ſpread along the

* The middle of June is the beſt ſeaſon for ſowing turnips; but thoſe who have great quantities are obliged to begin ſooner, as they ought all to be ſown in this month. The firſt ſown ought alſo to be firſt eaten, to prevent ſhooting.

bottom

bottom of the drills, ſhould immediately be ploughed down, that it may loſe none of its moiſture, or volatile particles, by evaporation. In covering the dung, the furrows are laid back; and what was formerly a top, is now a bottom. In dry weather, the ſowing ought not to be delayed, leſt the vegetating ſap be exhaled. The drill-barrows are run along the tops of the drills, being preceded by a light roller, which, by ſomewhat levelling the tops, makes the barrow run the more readily in a ſtraight line; and this is of ſome conſequence in the future operations. It alſo breaks any ſmall clods that may be turned up by the plough. The barrows ſow the ſeed at ſomewhat above a pound *per* acre; and put the ſeed about an inch into the ground, by means of the coulter.

Whenever the young plants are diſtinctly viſible, the cleaning muſt be ſet about without loſs of time; the hand-hoers carefully clearing away all the weeds from each ſide. The turnips muſt alſo be thinned, and ſet off to the diſtance of about eight or nine inches, though an exact diſtance cannot always be obſerved. Sometimes there are blanks; at other times there are ſuperior turnips, which muſt always be ſpared, if poſſible. If the turnips have a very equal breard, it is better to ſet them off at equal diſtances; but, if two very ſuperior ones ſhould happen to be

within four inches of each other, it will often be prudent to leave them; giving them the more room on the outfides, by taking away other plants that are not fo promifing: they will pufh towards the empty fpaces till they probably arrive at a great fize; and will touch and prefs one another till they are flat on the touching fides.

After the turnips are thus hand-hoed, and properly thinned, the earth may be ploughed away from them, going within three or four inches of the plants. As this furrow cannot be deep, and as fome of the weeds may have efcaped the plough, the horfe-hoe may be drawn up the middle with fuccefs, and deftroy what efcaped. It will often happen, that before they are cleaned the firft time, it will be neceffary to begin again at thofe firft hoed, and to hoe as before. Perhaps fome were too fmall, the firft cleaning, to bear fingling, which muft now be rectified; for they will never thrive when left too thick.

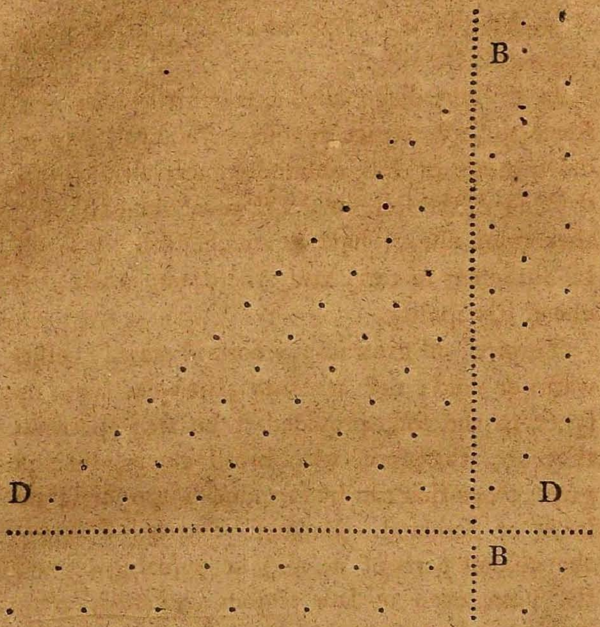
After this hoeing, the earth that was laid away before, fhould now be laid back by the plough, to enlarge the pafture of the plants. A third hoeing is feldom neceffary, if the two firft have been properly executed; but, if needful, let them have it by all means.

Since finifhing the defcription of drilled turnips, fome arguments have occurred that are

uſed by the Broadcaſtites. The common method of laying ridges, ſay they, is as perpendicular to the riſing ground as poſſible. In drilling along theſe ridges, there are ſo many furrows in the drills, that in a heavy rain much of the fineſt of the earth is run down, and waſhed away, by the rapidity of the water. They alſo ſay, that in laying the dung in the drills, and ploughing ſtraight up the ridges, it is never mixed with the intermediate ſpaces, but lies where it was firſt laid. There is ſome weight in both theſe objections; for theſe reaſons, ſome people try to drill acroſs the fields; but few fields are ſufficiently dry to juſtify ſuch a practice.

I have, for ſome years paſt, tried a medium betwixt theſe extremes, and drawn the drills in a diagonal direction. Thus, ſuppoſing the ridges to lie ſtraight up the paper, I begin drilling at a corner of the field, as is ſhewn in the following page.

By



By this method, the dung is ſeparated, either in ploughing or harrowing. When they go up the ridges, from B to B, they cut the drills a little acroſs. The firſt harrowing is up and down the ridges, from B to B, which divides the dung in part; the ſecond harrowing is generally acroſs the field, leſt any place ſhould be miſſed by the harrows going always in the ſame track. When the harrows croſs the ridges, they ſtill cut the drills, by going from D to D. The dung, being ploughed up, is pretty well ſcattered through the field,

field, by the action of the harrows going along and acrofs the ridges.

In drilling diagonally, one muft not be confined to any particular rule. The drills may be drawn more or lefs obliquely, according to the drynefs of the foil, or the flope of the field: but they muft always have as much declivity as will be fufficient to carry away the water, while they check its rapidity.

Turnips will grow in any corn climate, whether warm or cold; nor are they particular with refpect to the foil, provided it be free and dry: they are, therefore, with broad clover, the beft green crops that can be introduced into the Highlands of Scotland. Both of them will thrive in the coldeft parts of it, and be valuable once in the year, even in late feafons; whereas, white crops are fometimes loft entirely, from latenefs, in bad years. Both of them are a healthy food for fatting cattle, for milch cows, or a breeding ftock. In feeding, the cattle muft have what they can eat; but, in breeding, turnips will go a great deal farther; as the quantity required to feed one, will keep three young cattle in good condition, provided they are not ftinted in hay or ftraw.

Potatoes, like turnips, require a free, dry foil. They are eafily managed; and anfwer beft in drills, for the benefit of the ground, as drills are a fpecies

a ſpecies of fallow: they ſhould be planted in April. After the ground is laid up in drills, as for turnips, the drills are opened, and dung put between them, in the ſame manner; while the cuts, or ſets, of the potatoes, are planted immediately above the dung. After planting, the drills are reverſed; and managed with ploughs, horſe-hoes, and hand-hoes, through the whole ſeaſon, like turnips. (See page 122.) I believe potatoes and beans are, in ſome places, accounted black crops; but, as their effects are ſimilar, in cleaning the fields from weeds, and changing the ſyſtem of cropping, I have ranked them with green ones. Potatoes are an uſeful root, either for man or beaſt: they may be given either to black cattle, horſes, or ſwine: but they muſt be uſed with diſcretion, and given out by meaſure. Cattle devour them ſo greedily, and in ſuch quantities, that they ſometimes prove hurtful, and even dangerous; and, whenever an animal's ſtomach is diſordered, it receives more injury than a week's feeding will make up again. Potatoes in large quantities bring a flux upon cattle, of which they are ſometimes very ill, and death is occaſionally the conſequence. A bear peck will be ſufficient for a cow of twenty-ſix ſtone weight, in the twenty-four hours, to be given in two or three feeds; but a little freedom may be uſed, more or leſs, as they are obſerved to agree with the

the cattle. They ought to be taken up in October, to avoid the froſt, as it entirely ruins potatoes.

As turnips and potatoes are a ſpecies of fallow, they are generally ſucceeded by barley, or oats, as beſt ſuits the ſoils where they are raiſed. Oats are commonly the ſureſt upon weak land, or what has formerly been treated as out-field. Old in-field will generally ſucceed in barley; but oats are the crop for high and cold climates; and though they give a ſmaller price than bear, to the boll, the additional quantity upon the acre will commonly do more than make up the deficiency. Both ought to be ſeed-furrowed two or three weeks before ſowing, as recommended for wheat, page 54. Whether I was then right, with reſpect to the cauſe, I will not pretend to ſay; but certain it is, that the effects of ſowing *hot-furr*, as it is commonly called, are ſuch, that nothing but the dread of loſing brearding ſap will juſtify this practice. If a ſhower intervenes betwixt the ſeed-furrow and the ſowing, it has a fine effect: it gently conſolidates the ſoil, when too looſe; and it ſwells the ſmall clods, till they fill up the too wide interſtices. Either the barley or the oats may be ſown with the quantities of rye-graſs and broad clover formerly recommended. If it is intended the land ſhould lie ſome years in paſture-graſs, ſix or ſeven lbs. of

white and yellow clovers, will be proper to be fown along with the other.

Having finifhed my obfervations upon cropping, in general, I proceed to make a few remarks upon the choice of feeds; and, fo far as I am able, fhall point out the diftinction betwixt good and bad. I begin with oats.

It is not eafy to fay what are the beft kinds of oats to be ufed in different diftricts. We find that the fame fort will have very different characters from two different tenants, in the fame neighbourhood, according to the various qualities of the foils, or their modes of farming. Common or Blainflie oats are the moft hardy; yielding good meal, with the beft and greateft quantity of ftraw of any: they are later than the Dutch, Poland, or red feed, and earlier than the Angus, or cold feed; and, could their ripening be depended upon, there are no better oats for a cold climate; but they often fuffer from being too late. Every kind of oats have their votaries; while all of them are reprobated in their turn. The Dutch and Poland are too eafily fhaken to be ufed in high climates: the red is, therefore, to be preferred; but they require the ground to be in good heart, otherwife there will be a fcarcity of ftraw. Yet, where the ground is in a high ftate of cultivation, they will always

be

be a great acquifition in a late climate. There are oats ufed in the neighbourhood of Carnwath, which do not require fuch fine culture as the red, and yield more ftraw: they are not of a fine quality, having rather coarfe hufks; but they are very prolific, with large heads, and I fuppofe the quantity may compenfate for quality. If they have lefs meal to the boll, they yield more bolls to the acre; fo that the meal may be nearly equal, the quantity of which is the beft criterion: they are earlier than the Blainflie, though not quite fo early as the red. I have tried them this year; and confider them as an improvement in late climates, where the ground cannot be in fufficiently fine tilth for the red.

TO BE CONCLUDED IN OUR NEXT.

XX. *Account of ſome Experiments made, in France, by order of the Government, reſpecting the Quality of Pewter.* *By M.* Coquebert.

Read at the Council of Weights and Measures.

Some new regulations about to be made, with reſpect to the pewter meaſures which are uſed for wine, vinegar, and ſeveral other liquors, rendered it neceſſary to take into conſideration the two following circumſtances reſpecting that metal.

Firſt. To determine what degree of purity pewter ſhould poſſeſs, in order to render it fit for the uſes above mentioned, without any riſk to health.

Secondly. To diſcover ſome ſimple and eaſy means by which the quality of pewter might at any time be aſcertained, without injury to the veſſels made of it.

In conſequence thereof, MM. Legendre, Gattey, and Coquebert, members of the Council of Weights and Meaſures, propoſed, ſome months ago, to the government, that a plan of enquiry ſhould

ſhould be undertaken, in conjunction with MM. Gillet, Lefevre, and Lelievre, members of the Council of Mines, by which the ſolution of the above queſtions might be accompliſhed.

Theſe commiſſioners deſired to be aſſiſted by MM. Fourcroy, Vauquelin, and Dillon; and, after a great number of delicate experiments, made with the greateſt care, by the united labour of the forementioned gentlemen, many new and intereſting facts were aſcertained, which have ſerved to fix the opinion of the government, with reſpect to thoſe points which were the objects of this enquiry.

The experiments of the above gentlemen have proved,

Firſt. That tin is more eaſily diſſolved than lead, and is diſſolved ſooner than lead, by the action of wine, or of vinegar.

Secondly. That lead is not ſenſibly oxidated by the above liquors, except at the line of contact of the air and the liquor; conſequently, a very ſmall ſurface only is affected.

Thirdly. That the moſt green and ſour wine that could be met with in the neighbourhood of Paris, diſſolved only an inſenſible quantity of lead, after having remained from eight to ten days in veſſels made of pewter which contained 18 *per cent.* of lead.

Fourthly.

Fourthly. That nearly the ſame effects took place when vinegar was uſed inſtead of wine; and that no ſenſible appearances were produced by re-agents, except when the pewter of the veſſels in which the vinegar had ſtood contained more than 18 *per cent.* of lead. In proportion as the vinegar becomes ſaturated with pewter, a ſmall quantity of tartrite of lead is depoſited; but the quantity of this depoſit is extremely ſmall, even when the veſſels in which the vinegar ſtands are of great diameter, and have a large internal ſurface.

Fifthly. When red wine remains in pewter veſſels, it loſes its colour. This effect ariſes from the colouring matter being precipitated, after being combined with oxide of tin. The precipitate does not appear to contain any lead; yet the taſte of the bad wine, made uſe of in this experiment, became more ſweet. There is, however, reaſon to think, that this effect aroſe rather from the precipitation of the colouring matter, and the ſaturation of a part of the acid of the wine, than from any lead contained therein.

From the above experiments, the commiſſioners concluded, that veſſels made of a mixture of tin and lead might be uſed for wine, and for vinegar, provided the proportion of the latter metal was not more than from 15 to 18 *per cent.* and that no injury to health need be apprehended,

from

from the uſe of veſſels made within the above mentioned proportions.

The object of the ſecond part of this enquiry was, to find ſome means by which the proportion of lead in pewter might eaſily be determined. The hydroſtatic balance is well known to offer the ſureſt method of doing it; yet this method has not been made uſe of in any country. Inſtead of it, various conjectural methods were adopted, ſuch as, the appearance of the metal, the flexibility of it, or other circumſtances equally uncertain. A chemical analyſis is capable of aſcertaining the matter with preciſion; but ſuch an analyſis would be tedious and troubleſome; beſides which, it would be neceſſary to take away a part of the veſſels themſelves, for the purpoſe of analyſis. An examination of the ſpecific gravity has none of theſe inconveniences; but, in order to make it the baſis of legal determination, it was neceſſary to aſcertain, by experiment, in what manner tin and lead, when united in various proportions, were affected in this reſpect. It had been ſuſpected, that mixtures of theſe two metals did not poſſeſs exactly that ſpecific gravity which they would appear to do by calculating upon that which each of them poſſeſs ſeparately. But, was their ſpecific gravity augmented or diminiſhed? did the two metals penetrate

trate each other when mixed, or was there, on the contrary, a greater vacuum between their particles than exiſted in them when ſeparate? Theſe were queſtions which experiments only could determine; for, the opinions of the philoſophers who have written on that ſubject were not uniform. Kæſtner, Hauſen, Hahn, and even Lavoiſier, believed that penetration took place. The ſpecific gravity reſulting from the mixture, ſays the latter, exceeds very much that which would be obtained by computing the volumes and maſſes. Kraft alone, in the Peterſburgh Tranſactions, vol. XIV, maintained the opinion of dilatation; but he reſted it only on one ſingle fact. Thoſe who have treated this ſubject in other places, particularly in the Memoirs of the Academy of Stockholm, have confined themſelves to calculations, without making any experiments; it became therefore neceſſary, above all things, to have recourſe to obſervation.

Tin and lead, in the moſt perfect ſtate of purity they could be procured, were mixed together in various proportions; great care was taken that they ſhould be well mixed together, and alſo that no cavity or air bubble ſhould be left in the mixture. Three different ſeries of theſe mixtures were made; and, upon being tried in the hydroſtatic balance, the reſults were found to be as follows.

Mixtures

Mixtures of tin and lead were found to poſ-ſeſs leſs ſpecific gravity than would have been obtained by calculation; conſequently, theſe two metals, inſtead of penetrating each other reſpectively, increaſe in bulk, when mixed together.

The following is the law of that increaſe, as far as it can be deduced from the above experiments.

When the quantity of lead was in the proportion of nine-tenths of the whole, the bulk of the mixture increaſed, or, in other words, the ſpecific gravity diminiſhed, twenty-ſix thouſandth parts.

8 parts of lead and	2 of tin, increaſed in bulk	40 thouſandth parts
7 ditto	3 ditto	48 ditto
6 ditto	4 ditto	47 ditto
5 ditto	5 ditto	46 ditto
4 ditto	6 ditto	45 ditto
3 ditto	7 ditto	43 ditto
2½ ditto	7½ ditto	39 ditto
2 ditto	8 ditto	33 ditto
1½ ditto	8½ ditto	30 ditto
1 ditto	9 ditto	23 ditto
½ ditto	9½ ditto	14 ditto

A much greater number of experiments were made on the mixtures in which the proportion

of tin exceeded that of lead; and particularly on those where the proportion of tin, to that of lead, was from 5 to 25 or 30 *per cent.* they being the proportions most frequently met with in commerce.

From these experiments a table was constructed, by means of which it is very easy (after weighing a pewter vessel, first in air, and then in water,) to determine what proportion of lead is mixed with the tin.

It is very true, that this method does not shew the other metals with which the tin may perhaps be mixed, such as, copper, bismuth, zinc, and antimony; but every one knows that only a very small proportion of these metals is mixed with the pewter used in commerce; for some of them injure the colour, or the quality of the metal; and others are at least as dear as lead or tin, consequently no advantage can be gained by using them.

XXI.

XXI. *Extract from a Memoir containing some Researches respecting the Duration of the Time of Gestation in the Females of different Animals.* By M. Tessier.

Read at the National Institute.

THE author first takes notice of the discussions which took place, about twenty years ago, among physiologists, respecting the possibility of the time of gestation being prolonged beyond the usual term. Bouvard and Louis maintained, in opposition to Bertin and Petit, that the time of gestation in animals was invariable. But the fact was not ascertained; on which account, M. Tessier resolved to investigate the subject, and for that purpose established a correspondence concerning it, and kept very exact journals of every circumstance that could tend to elucidate the matter. The result of his enquiries, which he offers to the National Institute, is as follows.

I. Cows.

One hundred and fixty cows were obferved.

14 calved from the 241ft to the 266th day, that is, from 8 months and 1 day to 8 months and 26 days.
3 ——— on the 270th day.
50 ——— from the 270th to the 280th day.
68 ——— from the 280th to the 290th day.
20 ——— on the 300th day.
5 ——— on the 308th day.

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Confequently, there were fixty-feven days between the two extremes.

II. Mares.

One hundred and two Mares were obferved.

3 foaled on the 311th day.
1 ——— on the 314th day.
1 ——— on the 325th day.
1 ——— on the 326th day.
2 ——— on the 330th day, that is, exactly at the end of 11 months.
47 ——— from the 340th to the 350th day.
25 ——— from the 350th to the 360th day.
21 ——— from the 360th to the 377th day.
1 ——— on the 394th day.

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This

This gives a latitude in the time of geſtation, of 83 days; and the following obſervation may be made reſpecting cows and mares, namely, that more of the firſt brought forth before the completion of the ninth month, than of the ſecond before that of the eleventh.

III. Sows.

Of theſe, only fifteen were obſerved.

1	brought forth young, which lived, on the 109th day, that is, 3 months and 19 days.
10	——— from the 110th to the 120th day.
2	——— on the 121ſt day.
1	——— on the 122d day.
1	——— on the 123d day.
15	

Conſequently, the difference between the two extremes was 14 days.

IV. Rabbits.

IV. Rabbits.

One hundred and thirty-nine were obſerved, during the courſe of three years.

1	brought forth on the 26th day.
2	——— on the 27th day.
3	——— on the 28th day.
53	——— on the 29th day.
50	——— on the 30th day.
21	——— on the 31ſt day.
9	——— on the 33d day.
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The difference between the two extremes, in theſe animals, was ſeven days.

M. Teſſier propoſes to make ſimilar enquiries reſpecting the hatching of the eggs of birds; on which ſubject, he mentions a curious obſervation, made by M. Darcet, namely, that, of the eggs of the ſame brood, 1 was hatched on the 13th day, 2 on the 17th, 3 on the 18th, and 5 on the 19th and 20th days; there were ſome others, which were not hatched.

XXII.

XXII. *Liſt of Patents for Inventions, &c.*

(Continued from Page 72.)

THOMAS BINNS, of Great Barlow-ſtreet, in the pariſh of St. Mary-le-bone, Water-cloſet maker; for a machine, anſwering the purpoſes of a portable water-cloſet, or bidet, and eaſy-chair, compriſed in one-third of the ſpace occupied by portable water-cloſets now in uſe. Dated November 4, 1799.

THOMAS FODEN, of the city of Coventry, Cotton-manufacturer; for a loom, for the purpoſe of warping, dreſſing, weaving, and piecing ſilk, cotton, woollen, or any other yarn. Dated November 4, 1799.

EDMUND PRIOR, of Brook-ſtreet, Holborn, Leather-ſeller; for a method of painting and colouring all kinds of leather. Dated November 4, 1799.

JOHN and JOSEPH WILLIAMS, of Holywell-ſtreet, in the pariſh of St. Clement Danes, Stationers; for an improved method of binding all ſorts of books. Dated November 4, 1799.

WILLIAM

WILLIAM TUNSTALL, of Nidd, in the parish of Ripley, in the county of York, Gentleman; for a portable hand-engine or machine for thrashing all kinds of grain. Dated November 9, 1799.

WILLIAM LANDER, of Mere, in the county of Wilts, Brass-founder; for a method of raising water by pumps, or other engines, by means of an apparatus for moving the piston-rod. Dated November 9, 1799.

JAMES BURNS, of the city of Glasgow, in the county of Lanark, Builder; for improvements applicable to fire-grates, stoves, furnaces, and chimneys. Dated November 23, 1799.

JAMES FUSSELL, of Mells, in the county of Somerset, Iron-manufacturer; and JAMES DOUGLASS, of Church-street, in the county of Surry, Engineer; for an apparatus composed of chains, wheels, rollers, and conductors, for lessening friction, in raising, lowering, driving, and conducting heavy bodies. Dated November 28, 1799.

EDWARD THOMASON, of Birmingham, Manufacturer; for improvements in the cocks of gun-locks, applicable to all kinds of fire-arms. Dated November 28, 1799.

Printed by JOHN NICHOLS, Red-Lion-Passage, Fleet-Street, London.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER LXIX.

Printed by John Nichols, Red-Lion-Paſſage, Fleet-Street, London.

XXIII. *Specification of the Patent granted to Mr.* William Lander, *of Mere, in the County of Wilts, Braſs-founder; for a Method of raiſing Water by Pumps, or other Engines, by Means of an Apparatus for moving the Piſton-rod.*

WITH A PLATE.

Dated Nov. 9, 1799.

To all to whom theſe preſents ſhall come, &c. Now know ye, that in compliance with the aid proviſo, I the ſaid William Lander do hereby declare, that my ſaid invention is deſcribed in the

manner hereinafter ſet forth, and in the annexed plan, the figures of which ſhew part or parts of a wheel or circle, moving a rack or racks by a rotary or continued circular motion, and cauſing the piſton-rod or rods to make a longer ſtroke, and thereby raiſe a greater quantity of water, with the ſame bore, power, and time, than by cranks, or any other mode now in uſe, where it may be applied.

Fig. 1, (Plate VII.) repreſents a ſemi-circle, whoſe radius ſuppoſe to be four inches, and periphery twelve inches; conſequently the length of the ſtroke of the piſton muſt be twelve inches, being connected with the rack. The power of a winch, (if uſed,) applied to the centre of motion at A, may be extended in proportion as ſix to one, or two feet to four inches. A, the centre of motion. B, ſemi-circular wheel, which alternately acts upon the racks C, C, and moves the piſton up and down perpendicularly, while it continues its own circular motion. D, D, grooved rollers, to guide the rack.

Fig. 2, repreſents three quarters of a circle, of the ſame radius as the preceding one; of courſe the arc is eighteen inches, being likewiſe the length of the ſtroke of the piſton: the other quarter of a larger circle, is to depreſs or ſink the piſton rod. A, the centre of motion.

Fig.

Fig. 3, is more peculiarly adapted to large pumps for mines, being a little more ſimple in its conſtruction, but on the ſame principle, and has the ſame effect, as Fig. 1.

Figs. 4 and 5, are about three quarters of a circle, for the ſame purpoſe, and have nearly the ſame effect, as Fig. 2.

Fig. 6, repreſents two ſemi-circles reverſed, (on one axis,) and their racks acting alternately, to work two pumps, one piſton riſing while the other is depreſſed; and, though only one pump raiſes the weight, or water, at once, yet both ſtrokes being made in one revolution, will be equal to twenty-four inches, (the radius of the wheel being four inches, as in Fig. 1;) each turn or revolution may be made in about the ſame time as a perſon can lift and depreſs the handle of a common pump, which raiſes no more than ſeven or eight inches of water.

Fig. 7, is on the ſame conſtruction as Fig. 1; but, by the addition of a weight on a beam, (as deſcribed in the figure,) is made to lift the water with one half the power as at Fig. 1, (the dimenſions being the ſame;) for example, ſuppoſe the weight to be raiſed be 400 lbs. if one of 200 lbs. is affixed to the beam at A, it reduces the weight to be raiſed to 200 lbs. there will then be 200 lbs. on each ſide, and the work will be regular,

whereas, in Fig. 1. it is lifted only on one side. Again, suppose 400 lbs. to be lifted by Fig. 6, (which weight will be continued through the whole revolution,) by a lever in proportion as six to one, the same weight may be lifted by Fig. 7, by a lever proportioned as three to one, *i. e.* two feet to eight inches, by fixing 200 lbs. to the beam; the power being, in this case, but one half as much as in the other, and the weight also reduced one half, the stroke will be twenty-four inches, as in Fig. 6.

The different forms delineated in the annexed plate, are principally to shew that the form may be varied according to the purpose requiring it, or at the option or fancy of any person; and they will admit of a still greater variety of construction, without departing from the original principle of the invention. In witness whereof, &c.

We are desired by the Patentee, to add the following remarks on the method of raising water above described.

The advantage the semi-circle has over cranks, may be seen by the annexed drawing, Fig.

Fig. 8 *, which ſhews the deficiencies of the crank, in effecting a motion of the beam or lever. As the crank or cam makes a ſtroke no more than double its length, it is evident it muſt paſs from A to B, in its circular motion downward, to effect that portion of the ſtroke of the piſton at the other end of the beam that lies between A and B, in the perpendicular line at the crank; whereas, if it was a ſemi-circle and rack, it would be as much in the perpendicular ſtroke as in the circular motion. The ſame defect is likewiſe at bottom, loſing, in the whole ſtroke, the full length of the crank; as, ſuppoſe the crank three feet, the ſtroke will be ſix feet; but, if a ſemi-circle of the ſame dimenſions was uſed, the ſtroke would be nine feet, which would require a crank four feet and a half to effect.

The common forcing engine for extinguiſhing fires, has about nine inches ſtroke in each piſton; which is eighteen inches for the raiſing and depreſſing the lever or handle: the power about four to one, or three feet to nine inches. Now, if ſemi-circles were applied, inſtead of the

* It is hardly neceſſary to obſerve, that this figure (which we have, to ſave room, put on the ſame plate with the others) makes no part of the ſpecification.

quarters,

quarters, (which would be moved in the fame time, as inftanced before in the common pump, on account of the check at top and bottom in the alternate method of working,) they would produce a ftroke equal to thirty-fix inches, by a femi-circle of fix inches radius, worked by a winch of two feet. The femi-circle may alfo be applied, with the fame advantage, to the cylinders ufed in forges, where cranks are ufed, as it will difcharge an additional quantity of air, in the fame proportion as water.

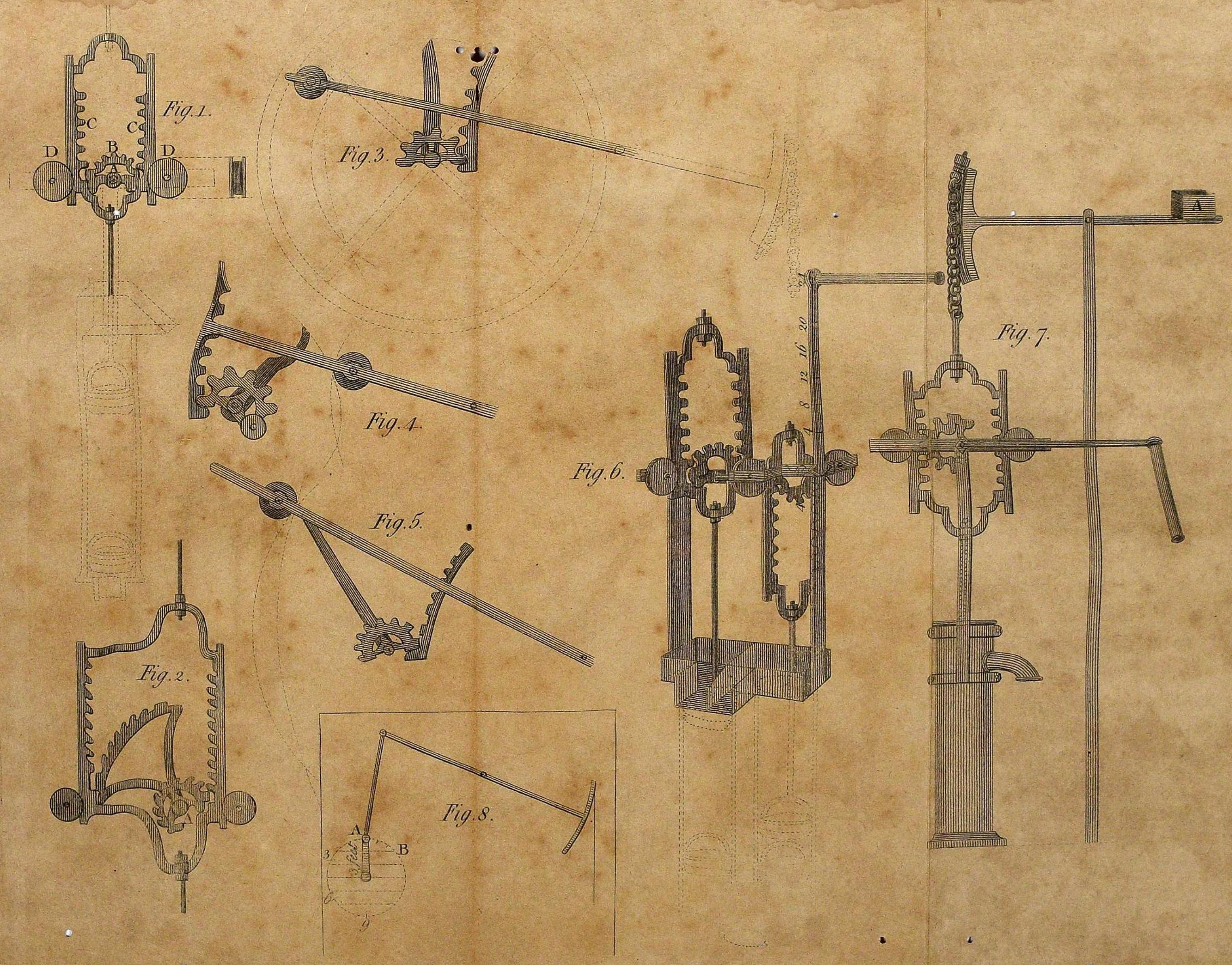


Fig. 1.
C
C
B
D
D
A
Fig. 2.
A
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
20
16
12
8
4
Fig. 7.
A
Fig. 8.
A
B
3
9

XXIV. *Specification of the Patent granted to Mr.* William Reynolds, *of Ketley, in the Parish of Willington, in the County of Salop, Ironmaster; for a Method of preparing Iron for the Conversion thereof into Steel.*

Dated Dec. 6, 1799.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Reynolds do hereby declare, that my said invention is described in manner following; that is to say: My method consists in mixing the oxide of manganese, or manganese, either with the materials from which I procure the pig or cast iron, or with the cast iron, in any of the processes used, or to be used, for the conversion of cast iron into steel, natured or malleable iron, whether in the finery, bloomery, puddling, or other furnace. In witness whereof, &c.

XXV. *Specification of the Patent granted to Mr.* CATER RAND, *of Lewes, in the County of Suſſex; for an improved Military and Naval Teleſcope, for aſcertaining Diſtances, and the Size or Extenſion of Objects, at Sight, by Means of a new Micrometrical Adjuſtment.*

WITH A PLATE.

Dated January 26, 1799.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that in compliance with the ſaid proviſo, I the ſaid Cater Rand do hereby declare, that my ſaid invention of an improved military and naval teleſcope, and new-invented micrometer thereto adapted, for aſcertaining diſtances, and the ſize and extenſion of objects, is deſcribed in the plan hereunto annexed, and the following deſcription thereof.

The teleſcope is made refracting, achromatic, or reflecting; and the micrometer has four parallel hairs, or wires, fitted to ſilver, braſs, copper, or other well contrived converging and diverging plates; two

two of which parallel hairs, or wires, have a permanent and fixed value; and the other two are valued in proportion to their degree of divergency, meaſured in parts of a great circle; and are put into motion, governed, and regulated, by a proper mechanical movement, which at one and the ſame time acts upon the diverging or converging parallel hairs or wires, and gives a vertical motion to a ſcale, by the ſide of a ſtationary vernier or nonius index, whoſe reſpective diviſions are calculated to meaſure the minutes of a degree of a great circle. The vernier or nonius at the ſame time, performing its proper office, ſubdivides the minutes of the moving ſcale into tenths, equal in value to 6″ or ſeconds of a great circle, read off from the bottom towards the top of the index ſcale, placed to the right of the micrometer ſcale; immediately oppoſite to which is placed a ſmall lens, of ſufficient magnifying power for reading off the diviſions, and eaſily directed to its proper focus, to ſuit the eye of the obſerver.

The whole of the above apparatus (except the lens, which is fixed before the index, at the diſtance of half an inch, or thereabouts, according to its focal diſtance) is framed together, and properly fitted on the eye-tube of the teleſcope, which being brought to its proper focus, in the uſual way for viewing objects, is then fitted for

 obſervation,

obſervation, for meaſuring the angle ſubtended by any object, for finding its diſtance by a ſingle obſervation, if its height or ſize be known, or by two obſervations and the intermediate diſtance, when neither diſtance, ſize, or height, are known, but both required, in manner following. If the angle ſubtended by any object be ſought in the table of diſtances placed on the outſide tube of every teleſcope, and its correſponding tabular number be multiplied by the known ſize or height of the object, in any meaſure, the diſtance of the object will be found in the ſame meaſure. If the height be required from the known diſtance, the tabular number correſponding to the angle, as before, divided by the diſtance, will give the height or ſize, and this by one obſervation. If the diſtance, and ſize or height of an object, or both, be required, when neither is known, the intermediate diſtance, paced or meaſured between two ſtations, multiplied into the larger angle ſubtended by the object, and that product divided by the difference of the angles taken at each ſtation or place of obſervation, will give the diſtance from the fartheſt ſtation or place of obſervation, from which, if the intermediate diſtance be taken, it will leave the diſtance from the neareſt place of obſervation to the object; dividing the tabular number, as before, by either diſtance correſponding with the ſubtending

tending angle, will give the fize or height of the object. Hence, at one ftation or place of obfervation, the diftance of an object may be found, if the angle fubtended by that object be truly taken, and the fize or height be known, and the height or fize of the diftance be known. Hence alfo, from two ftations, or from two places of obfervation, and the known intermediate diftance, both the diftance and height or fize of an object may be found, when neither of them is known. In witnefs whereof, &c.

References to the Figures.

(See Plate VIII.)

Fig. 1, general view of the telefcope, partly drawn out, to fhew the tubes, micrometer part, table of diftances, &c.

Fig. 2, fhews all the parts of the micrometer, as they appear adjufted for obfervation, fixed in the eye-tube of the telefcope, and facing the eye-glafs.

Fig. 3. fhews the back part of the micrometer, towards the object-glafs.

A, B, C, D, E, F, G, H, I, K, fhew the feveral parts forming the principles and value of the micrometer, as adapted to the patent telefcope; the angle fubtended by an object being

found by the diverging, converging, or fixed value of the parallel plates, hairs, or wires, *a*, *b*, *c*, in the centre of Fig. 2, *a* being double, though appearing as one.

A, ſhews the micrometrical ſcale, to find the value of the ſubtending angle, aſſiſted by B, the vernier or nonius, fixed oppoſite and parallel to the moving ſcale, put into motion by the double-threaded male ſcrew I, paſſing through the piece E, and through the female ſcrew-piece F, into the piece z, affixed to plate D, as it appears at z, Fig. 2.

C and D, are ſimilar plates: part of C, in Fig. 2, only can be ſeen, as at *c*. To theſe plates the parallel hairs or wires are fixed.

G and H, are two braſs plates, fixed to ſimilar ones, to form a groove, for the micrometer plates C and D to move in, and to keep them true and ſteady.

K, is a ſmall lens, to read off the diviſions on the micrometer ſcale.

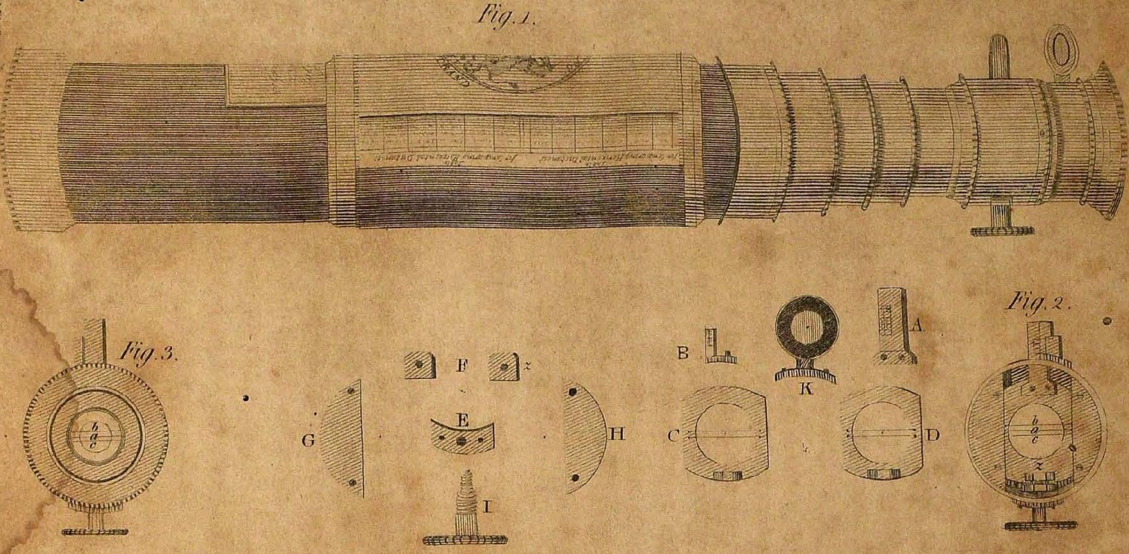


Fig. 1.
Fig. 2.
Fig. 3.
A
B
C
D
E
F
G
H
I
K
z
b
a
c

XXVI. *Specification of the Patent granted to Mr.* JAMES TURNER, *of the City of Weſtminſter, Gentleman; for his Method of producing a Yellow Colour for painting in Oil or Water, making White-Lead, and ſeparating mineral Alkali from common Salt; all to be performed in one ſingle Proceſs.*

Dated February 26, 1780.—Term expired.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that I the ſaid James Turner, in compliance with the ſaid proviſo, do hereby deſcribe and aſcertain the nature of my ſaid invention, and declare that the ſame is performed in manner following; that is to ſay: Take any quantity of lead, and calcine it, or minium or red-lead, or litharge, lead-aſh, or any calx or preparation of lead fit for the purpoſe. To any given quantity of the above-mentioned materials, add half the weight of ſea-ſalt, with a ſufficient quantity of water to diſſolve it, or rock-ſalt, or ſal-gem, or foſſil ſalt, or any marine ſalt proper for

for the purpofe. Mix them together, by trituration, till the lead becomes impalpable, or fufficiently comminuted. When the materials have been ground, let them ftand for twenty-four hours, in which time the lead will be changed to a good white, and the falt decompounded; if not, the trituration muft be repeated, with the farther addition of falt, till the white colour be obtained. The decompofition of the falt may alfo be brought about by digeftion, or by calcination. The materials may be fuffered to remain together, before the alkali be feparated by the addition of water, for a longer time than is fpecified above, according to the difcretion of the operator, and the end he wifhes to obtain.

The yellow colour is produced by calcining the lead, after the alkali has been feparated from it, till it fhall acquire the colour wanted: this will be of different tints, according to the continuance of the calcination, or the degree of heat employed.

The white-lead muft be finifhed by repeated ablutions, and by bleaching it till the white be made perfect. In witnefs whereof, &c.

XXVII.

XXVII. *An Account of ſome Experiments on the Fecundation of Vegetables.* By THOMAS ANDREW KNIGHT, *Eſq.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

THE reſult of ſome experiments which I have amuſed myſelf in making on plants, appearing to me to be intereſting to the naturaliſt, by proving the exiſtence of ſuperfœtation in the vegetable world, and being likely to conduce to ſome improvements in agriculture, I have thought proper to communicate them to the public.

The breeders of animals have very long entertained an opinion, that conſiderable advantages are obtained by breeding from males and females not related to each other. Though this opinion has lately been controverted, the number of its oppoſers has gradually diminiſhed; and I can ſpeak from my own obſervation and experience, that animals degenerate, in ſize at leaſt, on the ſame paſture, and in other reſpects under the

ſame

ſame management, when this proceſs of croſſing the breed is neglected.

The cloſe analogy between the animal and vegetable world, and the ſexual ſyſtem equally pervading both, induced me to ſuppoſe, that ſimilar means might be productive of ſimilar effects in each; and the event has, I think, fully juſtified this opinion. The principal object I had in view, was to obtain new and improved varieties of the apple, to ſupply the place of thoſe which have become diſeaſed and unproductive, by having been cultivated beyond the period which nature appears to have aſſigned to their exiſtence. But, as I foreſaw that ſeveral years muſt elapſe before the ſucceſs or failure of this proceſs could poſſibly be aſcertained, I wiſhed, in the interval, to ſee what would be its effects on annual plants. Amongſt theſe, none appeared ſo well calculated to anſwer my purpoſe as the common pea; not only becauſe I could obtain many varieties of this plant, of different forms, ſizes, and colours; but alſo, becauſe the ſtructure of its bloſſom, by preventing the ingreſs of inſects and adventitious farina, has rendered its varieties remarkably permanent. I had a kind growing in my garden, which, having been long cultivated in the ſame ſoil, had ceaſed to be productive, and did not appear to recover the whole

of

of its former vigour, when removed to a ſoil of a ſomewhat different quality; on this, my firſt experiment, in 1787, was made. Having opened a dozen of its immature bloſſoms, I deſtroyed the male parts, taking great care not to injure the female ones; and, a few days afterwards, when the bloſſoms appeared mature, I introduced the farina of a very large and luxuriant gray pea into one half of the bloſſoms, leaving the other half as they were. The pods of each grew equally well; but I ſoon perceived, that in thoſe into whoſe bloſſoms the farina had not been introduced, the ſeeds remained nearly as they were before the bloſſoms expanded, and in that ſtate they withered. Thoſe in the other pods attained maturity, but were not in any ſenſible degree different from thoſe afforded by other plants of the ſame variety; owing, I imagine, to the external covering of the ſeed (as I have found in other plants) being furniſhed entirely by the female. In the ſucceeding ſpring, the difference, however, became extremely obvious; for the plants from them roſe with exceſſive luxuriance, and the colour of their leaves and ſtems clearly indicated, that they had all exchanged their whiteneſs for the colour of the male parent: the ſeeds produced in autumn were dark gray. By introducing the farina of another white variety,

 (or,

(or, in ſome inſtances, by ſimple culture,) I found this colour was eaſily diſcharged, and a numerous variety of new kinds produced, many of which were, in ſize, and in every other reſpect, much ſuperior to the original white kind, and grew with exceſſive luxuriance, ſome of them attaining the height of more than twelve feet. I had frequent occaſion to obſerve, in this plant, a ſtronger tendency to produce purple bloſſoms, and coloured ſeeds, than white ones; for, when I introduced the farina of a purple bloſſom into a white one, the whole of the ſeeds in the ſucceeding year became coloured; but, when I endeavoured to diſcharge this colour, by reverſing the proceſs, a part only of them afforded plants with white bloſſoms; this part ſometimes occupying one end of the pod, and being at other times irregularly intermixed with thoſe which, when ſown, retained their colour. It may perhaps be ſuppoſed, that ſomething might depend on the quantity of farina employed; but I never could diſcover, in this, or in any other experiment in which ſuperfœtation did not take place, that the largeſt or ſmalleſt quantity of farina afforded any difference in the effect produced.

The diſſimilarity I obſerved in the offspring afforded by different kinds of farina, in theſe experiments, pointed out to me an eaſy method of aſcertaining

aſcertaining whether ſuperfœtation (the exiſtence of which has been admitted amongſt animals) could alſo take place in the vegetable world. For, as the offspring of a white pea is always white, unleſs the farina of a coloured kind be introduced into the bloſſom, and, as the colour of the gray one is always transferred to its offspring, though the female be white, it readily occurred to me, that if the farina of both were mingled, or applied at the ſame moment, the offspring of each could be eaſily diſtinguiſhed.

My firſt experiment was not altogether ſucceſsful; for the offspring of five pods (the whole which eſcaped the birds) received their colour from the coloured male. There was, however, a ſtrong reſemblance to the other male, in the growth and character of more than one of the plants; and the ſeeds of ſeveral, in the autumn, very cloſely reſembled it in every thing but colour. In this experiment, I uſed the farina of a white pea, which poſſeſſed the remarkable property of ſhrivelling exceſſively when ripe; and, in the ſecond year, I obtained white ſeeds, from the gray ones above mentioned, perfectly ſimilar to it. I am ſtrongly diſpoſed to believe, that the ſeeds were here of common parentage; but I do not conceive myſelf to be in poſſeſſion of facts ſufficient to enable me to ſpeak with deciſion on this queſtion.

If, however, the female afford the firſt organiſed atom, and the farina act only as a ſtimulus, it appears to me by no means impoſſible, that the exploſion of two veſicles of farina, at the ſame moment, (taken from different plants,) may afford ſeeds (as I have ſuppoſed) of common parentage; and, as I am unable to diſcover any ſource of inaccuracy in this experiment, I muſt believe this to have happened.

Another ſpecies of ſuperfœtation (if I have juſtly applied that term to a proceſs in which one ſeed appears to have been the offspring of two males) has occurred to me ſo often, as to remove all poſſibility of doubt as to its exiſtence. In 1797, the year after I had ſeen the reſult of the laſt mentioned experiment, having prepared a great many white bloſſoms, I introduced the farina of a white and that of a gray pea, nearly at the ſame moment, into each; and as, in the laſt year, the character of the coloured male had prevailed, I uſed its farina more ſparingly than that of the white one; and now almoſt every pod afforded plants of different colours. The majority, however, were white; but the characters of the two kinds were not ſufficiently diſtinct to allow me to judge with preciſion, whether any of the ſeeds produced were of common parentage or not. In the laſt year, I was more fortunate: having prepared

pared bloſſoms of the little early-frame pea, I introduced its own farina, and immediately afterwards that of a very large and late gray kind, and I ſowed the ſeeds thus obtained in the end of the laſt ſummer. Many of them retained the colour and character of the ſmall early pea, not in the ſlighteſt degree altered, and bloſſomed before they were eighteen inches high; whilſt others, (taken from the ſame pods,) whoſe colour was changed, grew to the height of more than four feet, and were killed by the froſt, before any bloſſoms appeared.

It is evident, that in theſe inſtances ſuperfœtation took place; and it is equally evident, that the ſeeds were not all of common parentage. Should ſubſequent experience evince, that a ſingle plant may be the offspring of two males, the analogy between animal and vegetable nature may induce ſome curious conjecture, relative to the proceſs of generation in the animal world.

In the courſe of the preceding experiments, I could never obſerve that the character, either of the male or female, in this plant, at all preponderated in the offspring; but, as this point appeared intereſting, I made a few trials to aſcertain it; and, as the foregoing obſervations had occurred in experiments made principally to obtain new and improved varieties of the pea, for

garden

garden culture, I chose, for a similar purpose, the more hardy varieties usually sown in the fields. By introducing the farina of the largest and most luxuriant kinds into the blossoms of the most diminutive, and by reversing this process, I found that the powers of the male and female, in their effects on the offspring, are exactly equal. The vigour of the growth, the size of the seeds produced, and the season of maturity, were the same, though the one was a very early, and the other a late variety. I had, in this experiment, a striking instance of the stimulative effects of crossing the breeds; for the smallest variety, whose height rarely exceeded two feet, was increased to six feet; whilst the height of the large and luxuriant kind was very little diminished. By this process, it is evident, that any number of new varieties may be obtained; and it is highly probable, that many of these will be found better calculated to correct the defects of different soils and situations, than any we have at present; for, I imagine that all we now possess, have in a great measure been the produce of accident; and it will rarely happen, in this or any other case, that accident has done all that art will be found able to accomplish.

The success of my endeavours to produce improved varieties of the pea, induced me to try some

ſome experiments on wheat; but theſe did not ſucceed to my expectations. I readily obtained as many varieties as I wiſhed, by merely ſowing the different kinds together; for the ſtructure of the bloſſom of this plant (unlike that of the pea) freely admits the ingreſs of adventitious farina, and is thence very liable to ſport in varieties. Some of thoſe I obtained were excellent; others very bad; and none of them permanent. By ſeparating the beſt varieties, a moſt abundant crop was produced; but its quality was not quite equal to the quantity, and all the diſcarded varieties again made their appearance. It appeared to me an extraordinary circumſtance, that in the years 1795 and 1796, when almoſt the whole crop of corn in the iſland was blighted, the varieties thus obtained, and theſe only, eſcaped, in this neighbourhood, though ſown in ſeveral different ſoils and ſituations.

My ſucceſs on the apple (as far as long experience and attention have enabled me to judge from the cultivated appearance of trees which have not yet borne fruit) has been fully equal to my hopes. But, as the improvement of this fruit was the firſt object of my attention, no probable means of improvement, either from ſoil or aſpect, were neglected. The plants, however, which I obtained from my efforts to unite the good

good qualities of two kinds of apple, ſeem to poſſeſs the greateſt health and luxuriance of growth, as well as the moſt promiſing appearance in other reſpects. In ſome of theſe, the character of the male appears to prevail; in others, that of the female; and in others, both appear blended, or neither is diſtinguiſhable. Theſe variations, which were often obſervable in the feeds taken from a ſingle apple, evidently ariſe from the want of permanence in the character of this fruit, when raiſed from ſeed.

The reſults of ſimilar experiments on another fruit, the grape, were nearly the ſame as of thoſe on the apple, except that, by mingling the farina of a black and a white grape, juſt as the bloſſoms of the latter were expanding, I ſometimes obtained plants, from the ſame berry, ſo diſſimilar, that I had good reaſon to believe them the produce of ſuperfœtation. By taking off the cups, and deſtroying the immature male parts, (as in the pea,) I perfectly ſucceeded in combining the characters of different varieties of this fruit, as far as the changes of form, and autumnal tints, in the leaves of the offspring, will allow me to judge.

Many experiments, of the ſame kind, were tried on other plants; but it is ſufficient to ſay, that all tended to evince, that improved varieties of

of every fruit and efculent plant may be obtained by this procefs, and that nature intended that a fexual intercourfe fhould take place between neighbouring plants of the fame fpecies. The probability of this will, I think, be apparent, when we take a view of the variety of methods which nature has taken to difperfe the farina, even of thofe plants in which it has placed the male and female parts within the fame empalement. It is often fcattered by an elaftic exertion of the filaments which fupport it, on the firft opening of the bloffom; and its exceffive lightnefs renders it capable of being carried to a great diftance by the wind. Its pofition within the bloffom, is generally well adapted to place it on the bodies of infects; and the villous coat of the numerous family of bees, is not lefs well calculated to carry it. I have frequently obferved, with great pleafure, the difperfion of the farina of fome of the graffes, when the fun had juft rifen in a dewy morning. It feemed to be impelled from the plant with confiderable force; and, being blue, was eafily vifible, and very ftrongly refembled, in appearance, the explofion of a grain of gunpowder. An examination of the ftructure of the bloffoms of many plants, will immediately point out, that nature has fomething more in view, than that its own proper males fhould fecundate

 each

each bloſſom; for the means it employs are always thoſe beſt calculated to anſwer the intended purpoſe. But the farina is often ſo placed, that it can never reach the ſummit of the pointal, unleſs by adventitious means; and many trials have convinced me, that it has no action on any other part of it. In promoting this ſexual intercourſe between neighbouring plants of the ſame ſpecies, nature appears to me to have an important purpoſe in view; for, independent of its ſtimulative power, this intercourſe certainly tends to confine within more narrow limits, thoſe variations which accidental richneſs or poverty of ſoil uſually produces. It may be objected, by thoſe who admit the exiſtence of vegetable mules, that, under this extenſive intercourſe, theſe muſt have been more numerous; but my total want of ſucceſs, in many endeavours, to produce a ſingle mule plant, makes me much diſpoſed to believe that hybrid plants have been miſtaken for mules; and to doubt (with all the deference I feel for the opinions of Linnæus and his illuſtrious followers) whether nature ever did, or ever will, permit the production of ſuch a monſter. The exiſtence of numerous mules in the animal world, between kindred ſpecies, is allowed; but nature has here guarded againſt their production, by impelling every animal to ſeek its proper mate; and, amongſt the

the feathered tribe, when, from perverſion of appetite, ſexual intercourſe takes place between thoſe of diſtinct genera *, it has, in ſome inſtances at leaſt, rendered the death of the female the inevitable conſequence. But, in the vegetable world, there is not any thing to direct the male to its proper female: its farina is carried, by winds and inſects, to plants of every different genus and ſpecies; and it therefore appears to me, (as vegetable mules certainly are not common,) that nature has not permitted them to exiſt at all.

I cannot diſmiſs this ſubject, without expreſſing my regret that thoſe who have made the ſcience of botany their ſtudy, ſhould have conſidered the improvement of thoſe vegetables which, in their cultivated ſtate, afford the largeſt portion of ſubſiſtence to mankind and other animals, as little connected with the object of their purſuit. Hence it has happened, that whilſt much attention has been paid to the improvement of every ſpecies of uſeful animal, the moſt valuable eſculent plants have been almoſt wholly neglected. But, when the extent of the benefit which would ariſe to the agriculture of the country, from the poſſeſſion of varieties of plants

* This is ſaid to be the caſe with the drake and the hen.

which, with the ſame extent of ſoil and labour, would afford even a ſmall increaſe of produce, is conſidered, this ſubject appears of no inconſiderable importance. The improvement of animals is attended with much expence, and the improved kinds neceſſarily extend themſelves ſlowly; but a ſingle buſhel of improved wheat, or peas, may in ten years be made to afford feed enough to ſupply the whole iſland; and a ſingle apple, or other fruit-tree, may within the ſame time be extended to every garden in it. Theſe conſiderations have been the cauſe of my communicating the foregoing obſervations at this time; for it was much my wiſh to have aſcertained, before I made them public, whether, in any inſtance, a ſingle plant can be the offspring of two male parents. The deciſion of that queſtion muſt of neceſſity have occupied two years, and muſt therefore be left to the teſt of future experiment.

XXVIII.

XXVIII. *On the Diſtillation of ardent Spirit from Carrots. By Dr.* HUNTER *and Mr.* HORNBY, *of York.*

From the TRANSACTIONS of the ROYAL SOCIETY of EDINBURGH.

ONE ton and eight ſtone of carrots, which, after being expoſed to the air a few days to dry, weighed one hundred and ſixty ſtone, and meaſured forty-two buſhels, were waſhed, topped, and tailed, by which they loſt in weight eleven ſtone, and in meaſure ſeven buſhels; being then cut, they were boiled, with the proportion of twenty-four gallons of water to one-third of the above quantity of carrots, until the whole was reduced to a tender pulp, which was done in three hours boiling. From this pulp the juice was eaſily extracted, by means of a preſs, and two hundred gallons of juice were produced from the whole. This juice was boiled again, with one pound of hops, five hours, and then cooled to 66° of Fahrenheit; and, ſix quarts of yeaſt being added, it was ſet to ferment. The ſtrong fer-

mentation

mentation lasted forty-eight hours, during which time, the heat abated to 58° of Fahrenheit. Twelve gallons of unfermented juice, which had been reserved, were then heated, and added to the liquor, the heat of which was thus raised again to 66°, and the fermentation was renewed for twenty-four hours more, the air of the brewhouse being all this time at 46° and 44°. The liquor was now tunned, and continued to work three days from the bung. Lastly, it was distilled; and the first distillation was rectified the next day, without any addition. The produce was twelve gallons of spirit *.

The refuse of the carrots weighed forty-eight stone, which, added to the tops and tails, made provision for hogs, besides the wash from the still, which measured one hundred and fourteen gallons.

From this experiment, which was made by Mr. Hornby, Dr. Hunter draws the following comparison between the distillation of carrots and that of grain.

* A sample of this spirit, which was sent along with the paper, was examined by Dr. Black, Dr. Hutton, and Mr. Russell: they found that it resembled a corn spirit, in flavour, but that it was equal to a corn spirit of the best kind, and that it was proof.

Twenty

Twenty tons of carrots, which will make two hundred gallons of proof-ſpirit, may be bought for 16 *l.*

Eight quarters of malt, or rather of materials for diſtillation, conſiſting of malt, wheat, and rye, may be bought for 16 *l.* and will alſo yield two hundred gallons of proof-ſpirit.

The refuſe from the carrots will be nine hundred and ſixty ſtone, which, at one penny *per* ſtone, will ſell for 4 *l.*

The refuſe, or grains, from the malt, &c. will be ſixty-four buſhels, each buſhel about three ſtone, which, at one penny *per* ſtone, will ſell for 16 *s.*

Dr. Hunter, however, ſuppoſes that the manufacturing of the ſpirit from carrots may be attended with more expence than the manufacturing of it from malt; but imagines that the greater value of the refuſe may compenſate for that expence; and that the ſaving of corn, for other purpoſes, is an object worthy of attention and encouragement.

XXIX.

XXIX. *Account of an improved Method of laying Water upon Water-Wheels.* By *Sir* Thomas Hanmer, *Bart. of Hanmer, in Flintshire.*

WITH A PLATE.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

THE old method of conveying water from a higher level to an over-ſhot mill-wheel, proving ſo deſtructive to the different timbers and working-gear of all mills of this deſcription, by the ſplaſhing and beating of the water overflowing the buckets, its extreme waſte of water, and the retrograde manner in which the waſte is diſcharged from the bucket cauſing rather a ſtagnation in the water under the wheel, where the fall is not very great; and floods being apt to dam or tail back, and thereby impede or clog the regular

regular motion of the wheel; have induced the proprietor to try the following plan hereunto annexed, and which has been adopted at an overſhot corn-mill, in Flintſhire, with the aſſiſtance of Mr. John Wilkinſon, Iron-maſter, of Birſham Forge, Denbighſhire.

REFERENCES TO THE FIGURES.

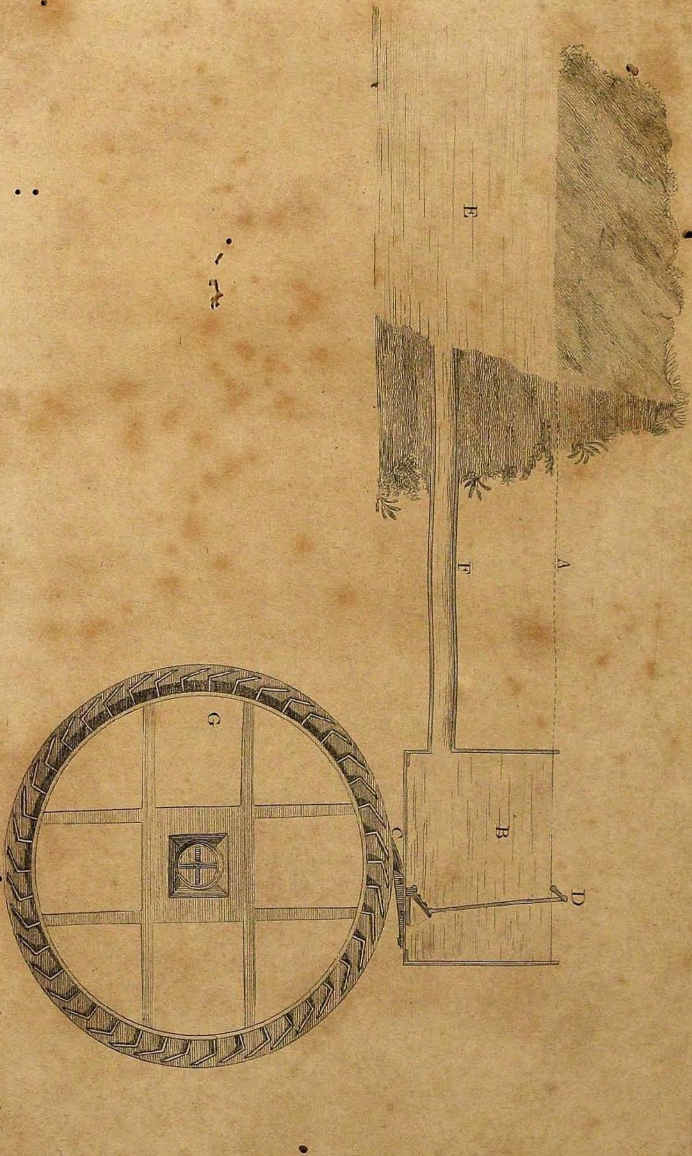
(See Plate IX.)

A. The line of high-water level.
B. The iron ciſtern.
C. The valve to the ciſtern.
D. The lever that lets the water on the wheel.
E. The pool dam.
F. The iron pipe, through which the water is conveyed from the pool to the ciſtern.
G. The large wheel.

By delivering the water from a valve in the ciſtern, (which is of caſt iron,) a little beyond the centre of the wheel, you are able to obtain the motion of an under-ſhot wheel, without the loſs of any water, or injury to the mill-work by perpetual ſplaſhing, as by the old method. There is alſo a great ſaving of water by this plan, ſo as to

enable the mill to do nearly double the work, with the same supply of water, compared with what it did in the old way. The motion is quicker; the wheel rids itself with greater ease; and the water passes off with great rapidity, and acts with greater power against floods and frost. The whole of the wheel and cistern should be covered from the weather. The bore of the pipe may be of any dimensions, according to the supply of water.

A cistern, &c. as above described, were completed at Hanmer, in the year 1797; and the proprietor, from the success he has experienced, is induced to lay an account of the plan before the public; not doubting, that if it is frequently adopted, it may admit of considerable improvement, and be of great utility.


E
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G

XXX. *Conclusion of Mr.* Brodie's *Observations on Green Crops.*

(From Page 131.)

It is prudent to change a great proportion of ſeed oats yearly; for, when long continued upon the ſame fields, they degenerate, and run to greys. In ordinary years, it may be enough to ſow ſo much of the earlieſt part of a late farm with changed ſeed, that the produce may be able to ſow the reſt of the farm next year; that is, a farm ſowing ſixty bolls of oats, may have ten of theſe changed ſeed; the produce whereof ſhould be fully ſufficient for ſowing next crop, allowing the light and weak grains to be cleaned out. Thus, the ſame ſeed will never be ſown above twice upon the ſame farm.

The rule for changing ſeed is, after being convinced, by experience, what oats are beſt adapted to the ſoil and climate, always to buy the very beſt and drieſt kinds, of a good ſhape, ſhort and well filled in the body, free from long

tails, greys, &c. In chuſing ſeed, one ought, after a late ſeaſon, to guard againſt froſted oats, which are known by their being of a whiter colour than thoſe well ripened; they are light in the hand, and have a ſort of empty jingle, from their being whitened by the froſts, before coming to maturity. Oats that have got much rain in the ſheaf, are alſo to be avoided. In ſhort, in late ſeaſons, we ought to ſelect whatever kinds of oats we uſe, from an earlier climate: I have frequently obſerved ſuch to ripen a week or two ſooner at harveſt. A farmer is ſometimes deterred from making the neceſſary exchange of his ſeed, from an apprehenſion of the expence, and grudges to be paying fifteen ſhillings, when he is only getting twelve ſhillings for his own. This, at firſt ſight, has the appearance of a loſing game; though it is only in appearance, but not in reality; for a boll of the beſt oats will be ſufficient to ſow a Scotch acre, which we have ſuppoſed to coſt fifteen ſhillings. If he ſows his own ſoft oats, which are always in a ſwelled ſtate, it will require five firlots; and theſe, at twelve ſhillings a boll, are as dear as the other: while poſſibly the ground is not ſo well ſown, as ſome of them, being damaged, will not grow at all; others, when they do ſpring, will be late, and full of greens at harveſt. Thus, the evil may be continued, and

multiplied

multiplied from one year to another. It is, therefore, the businefs of thofe who have to contend with inhofpitable climes, to procure their feed oats, after a late harveft, from thofe "whofe lines "have fallen in more pleafant places."

Bear fhould alfo be changed in the feed, though it is not fo neceffary as for oats. In chufing feed bear, all late and raw grain is to be avoided; but, in particular, hummeled grain, that is, bear whofe awns have been broken by the winds, before being ripe. This had a bad effect upon it for malting; and, for the fame reafon, it is unfit for feed: it is light, and has, like frofted oats, a fort of empty found, from its fkin not adhering to its body. Upon the whole, the beft feed will be the cheapeft in the end; for, though it fhould coft more, it will fow farther in proportion, and may be more depended upon. Let feed bear, therefore, be dry, fhort in the body, and well filled, with its fkin adhering firmly to its back.

Attention is particularly requifite, in chufing rye-grafs feed. It often happens that the feeds of couch-grafs, and other noxious weeds, are mixed with it, and introduced again into the fields. There is fuch a refemblance between the feeds of fome of thefe weeds and the weak feeds of rye-grafs, that, without particular attention, the

one may paſs for the other. This, to uſe a proverb, is keeping work in the workhouſe. After gathering the roots with the one hand, it is ſowing them with the other; for they propagate both by the ſeed and root.

It would appear ill-natured and invidious, to mention names with diſreſpect, in an eſſay of this ſort; but I have known a farmer who, to ſave thirty or forty ſhillings in ſowing down as many acres of well-prepared ground, went through all the ſtablers' lofts in Edinburgh, to purchaſe his rye-graſs ſeed: it will be unneceſſary to mention the conſequences. I once obſerved to him, that he never took up his fields ſo clean as he laid them down. He laid the blame upon the ſoil; ſaid it was as natural for his fields to produce couch-graſs, and other root weeds, as it was for other ſoils to produce annual plants; that both were the productions of nature, and that the weeds were congenial to the ſoil. I attempted to ridicule his notions of the equivocal generation of plants, or animals, but to no purpoſe; for ſo firmly rooted were the prejudices of this old man, that all I could ſay ſerved only to put him out of humour. Many of the merchants ſhops are ſupplied with ſuch a motley mixture, from the ſtablers' lofts. As rye-graſs ſeed is eaſily raiſed, it is almoſt in every ones power to ſave as much

from

from his hay as will ſerve himſelf; and, after getting into a clean ſort at firſt, if his fields are clean, his rye-graſs will be ſo likewiſe. It will not be amiſs to get ſome good clean Engliſh ſeed at firſt, to inſure a proper kind; but it is worth every farmer's while, to make himſelf maſter of the way by which good ſeeds may be diſtinguiſhed from thoſe of the weeds he wiſhes to extirpate.

There is no point in farming that requires more attention than the choice of good ſeeds, and, ſtrange to ſay, it is little attended to. Crops of turnips are often loſt, from this very cauſe. In merchants ſhops, ſeeds are often kept ſo long, as to prove very prejudicial to the farmer: in vain has he prepared his ground, if his crop is to be fruſtrated by bad ſeed. It is often hurt by being too long kept in damp cellars, or by being perforated by mites. Though it may, in general, ſpring, that is not ſufficient, ſince it muſt come away with vigour, and a ſtock of good health, otherwiſe it had better not ſpring at all; for, if it be in a weak feeble ſtate for the firſt two or three days, it will fall a prey to the turnip-fly, or the black dolphin. The firſt of theſe has ſpotted wings, and jumps like a flea. The ſecond is of the beetle kind, and, whenever it is ſtirred, rolls itſelf ſo as to appear like a turnip ſeed; and, when it ſees no danger, it gets

gets on foot again. This inſect lurks under the leaves of the tender plants, and,

> " With deſtruction keen,
> " Does horrid havoc ere the ſymptom's ſeen."

Beſides thoſe ſeen by the naked eye, we, by the aſſiſtance of a glaſs, diſcover myriads of ſmaller animalcula, preying upon the infant plants, until they effect their deſtruction:

> " They waſteful eat
> " Their eager way. A feeble race! yet oft
> " The ſacred ſons of vengeance; on whoſe courſe
> " Corroſive famine waits, and kills the year."
>
> THOMSON.

If a few plants ſhould ſurvive, they are ſo weak, from the wounds and punctures they have received, that they are long in a ſtate of ſuſpence; are not ready for cleaning, when other turnips are covering the ground; and thus loſe the beſt of the growing ſeaſon. But, when the ſeed is new and freſh, it comes away with ſuch vigorous and haſty ſtrides, that the plants are out of danger before the "inſect armies" have had time to annoy them: when they have got the rough leaf, they are pretty ſecure. As turnip ſeed is eaſily raiſed, it is worth while for a man, either to raiſe as much as will ſerve his own conſumption, or to endea-

vour

vour to get it from the firſt hand. I had a conſiderable loſs myſelf, this year, from old ſeed; and obſerved a great difference when I got a freſher ſort. Some of my neighbours laughed at my laying the blame upon the ſeed, and inſiſted that it was to be attributed entirely to the chapter of accidents. It is a new diſcovery to me; but I ſhall relate a caſe which happened this year, in the country, and will defy ſcepticiſm itſelf, to hang a ſingle doubt upon it. Mr. Colt, of Auldhame, let his farm of Scougal to Mr. John Brodie, at Whittingham, but reſerved a part of a field to himſelf. Mr. Colt and his tenant managed this divided field in the ſame ſtile, and both were ſown with turnips about the ſame time. The tenant's were thriving from their firſt outſet, and are, at preſent, a moſt excellent crop; while the proprietor's were ſo bad, that he was obliged to ſow the ground a ſecond time. Suſpicion fell upon the ſeed: both ſeeds were tried in flower-pots, filled with the ſame ſort of earth. Mr. Brodie's ſeed was up ſome days before the other, freſh and healthy: when the other did make its appearance, it was weak and feeble, as it had been in the field. Mr. Colt had probably got old ſeed from a merchant's ſhop, whilſt his tenant was ſupplied from the famous Meſſrs. Culleys, in Northumberland, who, it

would appear, know the importance of winning turnip ſeed.

I ſhall conclude with ſubjoining a few rules for raiſing the beſt ſeed. The turnips intended for this purpoſe ſhould be ſelected, and tranſplanted, in the month of October. I would recommend the ſpecies called Green-tops, to the Highlands; as they ſtand the winter well, grow to a good ſize, and are adapted to a cold climate. This is not all: we ought not only to chuſe the ſpecies, but the beſt plants of the ſpecies; theſe are, the ſmooth-ſkinned ones, with ſmall ſhaws, and ſingle roots; they muſt not be flat, but as globular as poſſible. Seed raiſed from ſuch plants will be better worth five ſhillings a pound, than the common run of ſeed is worth three farthings; it will often add twenty ſhillings an acre to the value of the crop. Mr. Brodie, of Upper Keith, has raiſed his turnip ſeed with great ſucceſs, by theſe rules, for a number of years paſt. One year he ran ſhort, and bought a part; and, having marked the drills, he found ten ſhot, in autumn, from the bought ſeed, to one from what he raiſed himſelf; and the ſame proportion rotted with the winter froſts.

On clover ſeeds I have very little to ſay; but will recommend it to the purchaſer to look out for the neweſt and freſheſt kinds. He may ſatisfy himſelf,

himſelf, by trying a few ſamples, in as many flower-pots; and let him keep by what has the moſt healthy and promiſing appearance, for clover is at times, when young, deſtroyed by inſects, like turnips; and whatever ſeed thrives faſteſt at firſt, ought to have the preference.

As I have a bad opinion of peaſe, I wiſh to ſay very little about them: they pay very little rent; and are juſtly ſuperſeded by the other green crops. One year they are too ſtrong, and have little or no corn, which puts nothing in the pocket; another year, when there is corn, there is a want of ſtraw, and the field is ruined with weeds.

I am afraid I ſhall be accuſed of having been tedious in this eſſay, in general, though more particularly upon the choice of ſeeds; but I flatter myſelf, that it is not deſtitute of uſeful information; and my principal aim has always been, to be underſtood; judging,

> "That, of the two, leſs dang'rous was th' offence,
> "To tire your patience, than miſlead your ſenſe."
>
> Pope.

XXXI. *Account of a ſimple and effectual Preparation of Seed-Corn.* *By* Mr. JOHN WAGSTAFFE, *of Norwich.*

From the Letters and Papers of the Bath and Weſt-of-England Society for the Encouragement of Agriculture, &c.

THERE has been long ſought for, and, in the opinion of ſome, long ſince obtained, a perfect cure of the diſeaſe in wheat and other grain, provincially known by various names, as ſmut, ſootbrand, &c. which are but one and the ſame diſeaſe.

From the partial judgment of many individuals, it has been aſſerted, that ſuch and ſuch cauſtics, ſalts, and waſhes, have been completely deſtructive of this bane; yet, however ſuch individuals may have eſcaped its malignity, the repeated uſe of their recipes has not ſucceeded with others to whom their proceſs has been communicated; but I am convinced, by a ſeries of repeated experiments, that every perſon, who duly practiſes

practiſes the ſimple means I now lay before you, will be exempted from its immediate bane; and a diſtrict of country, by purſuing the ſame means, may perhaps eſcape future contagion.

The means are ſimple; and are no other than immerſing the ſeed in pure water, and repeatedly ſcouring it therein, juſt before it is ſown or dibbled in the ſoil. Whether well, ſpring, or river water be uſed, is indifferent; but repeated ſtirring and change of water is eſſential, to remove the particles of infection that may have imperceptibly adhered to the ſeeds thus purified: the ſubſequent crop will be perfect in itſelf, and its ſeeds (I am perſuaded) ſucceſſively ſo likewiſe, if there are no adjacent fields from whence this contamination may be wafted. Before I give you a ſeries of experiments, which have confirmed to me the complete cure of the diſeaſe in queſtion, permit me to obſerve, that many years ſince, believing that this corrupt ſubſtance of ſmut occaſioned its perpetuation, I took ſome grains of wheat from a ſtock that had been known not to be affected with ſmut; theſe grains I blackened with its duſt, and the ſucceeding ſummer confirmed my opinion, as near half the produce was ſmut-balls. Here I ſtopped; and in my own ſmall practice uſed ſome of the ſtrongly recommended noſtrums that were ſaid always to effect a cure, and which apparently they did, as I uniformly

formly ſteeped the grain in rain water, before I made the addition of a diſguſtful fluid, or commixture of I know not what ſtrange ſubſtances.

About two years ſince, I was called upon by an intelligent farmer (Roger Treffey) of Devonſhire, who *confidentially* (becauſe he had a ſubſcription in view) laid this ſimple proceſs before me. I was immediately convinced, by comparing what I had practiſed with the principle he advanced.

I then repeated my former experiments. I took a handful of pure wheat, and blackened it, by rubbing in as much ſmut-brand as I was able; after which, I divided this corrupted handful into two equal parts; retained one part with all its corrupt impregnation *, and the other part I well cleanſed in water from its baneful particles: theſe two parts I again ſubdivided into three portions each, two of which I dibbled in different ſituations, *viz.* a portion of the pure and impure, near to, but diſtinctly ſeparated from, each other; two other portions ſome miles from the former two: and the remaining two, (the corrupted

* Wholeſome water has a tendency to promote vegetation; while ſome of the fetid and corroſive fluids have a tendency to deſtroy its principle; in courſe, ſome, perhaps much, of the ſeed periſhes in the ſoil.

and

and the cleansed,) I committed to the care of an accurate neighbour, for his putting into the ground, at which I was present, and witnessed the exactness of the separation. The products of these several trials were uniformly the same: the unwashed was generally smutty; the washed good in quality, one single set excepted. Thus fully convinced, and confirmed in the efficacy of the means recommended, I engaged the farmers of a certain parish (Baburgh) to advance me a guinea for Roger Treffey's publication, assuring the principal occupier *, that he would be con-

* This farmer had been subject many years to brand, notwithstanding his constant use of saline and other substances; at length he changed these for a recipe from a gentleman, to whose opinion he paid much deference; but it proved, that on this change he had more brand than before; he thence resolved to use no more preparations, but brought all his seed-wheat to the pump, and has not had (he says) any brand since. And, what is still more confirming, a gentleman farmer, in this vicinity, applied to me for Roger Treffey's process, in consequence of his whole crop of wheat being so excessively infected with smut, that his threshers daily, at the close of their labour, cleansed themselves *in* water, they being, as he expressed it, as black as chimney-sweepers; yet his subsequent crop of wheat from *this* seed, scoured in repeated washings, escaped the taint, except a piece of land in contiguity with the homestead; which this gentleman ascribed to the pollution which fled over it from divers dressings.

vinced

vinced of its certainty, without waiting the iſſue of a harveſt. The conſequence of which has been, that I have neither ſeen nor heard of a ſmutty ear in this diſtrict; which, I believe, hath in no preceding year been free from them. In fine, not only from the experiments already adverted to, but from others which might be adduced, I am fully perſuaded that the confirmation of this diſcovery (and it has been many years back ſuggeſted) will lead to an incalculable advantage; for it is not alone a preſervation of the moſt indiſpenſable article of human food from an appearance and flavour truly diſguſtful; but, while it renders it more nutritious, it alſo augments its quantity; for every ſmut-ball might have been a perfect grain, by uſing the ſimple proceſs referred to. To this let me add, that other kinds of bread, as well as that more generally uſed, may be augmented and improved; ſince barley and oats equally eſcape this contamination and diminution, if their ſeeds are equally purified.

XXXII. *Experiments on the extraordinary Quality of Butter made according to the Lancaſhire Manner. By Mr.* H. HARPER, *of Bank-Hall, near Liverpool.*

From the Letters and Papers of the Bath and Weſt-of-England Society for the Encouragement of Agriculture, &c.

THE Lancaſhire method of preparing milk for butter, previous to churning, may be ſeen in the Lancaſhire Report *. A few words may be here added,

* For the information of ſuch of our readers as may not have the Lancaſhire Report, we think proper to give the following extract from it.

The practice of managing the milk for butter, in this county, might be of ſervice, if followed in other places. Except in the county of Cheſter, it ſhould ſeem (as the ſurveyor underſtands) peculiar to this diſtrict. The mode is, dividing the milk into two parts; the firſt-drawn being ſet apart for family uſe, after being ſkimmed; the cream of which goes into veſſels appropriated to receive it, as alſo the

added, on working the butter, after being collected from the milk; if it is too warm, cold water is added, to harden the butter, whilſt working in its firſt ſtate over the churn; and afterwards a little ſalt is added, uſually about one ounce to the pound. After ſtanding ſome time in a cool place, it ſhould be worked twice over from the lump, by hand, and ſo effectually as

the whole of the ſecond or laſt-drawn milk, provincially called *afterings*, (about one half from each cow, each meal; but the quantity taken firſt, in ſome meaſure depends upon the conſumption of milk in the family.) Theſe two, being mixed together, are ſtirred, but not to a great depth, to prevent the bad effects of foul air accumulating on the ſurface, and kept, according to the ſeaſon of the year, expoſed to the fire, to bring on fermentation and ſourneſs, which is accelerated by that which may remain in the pores of the veſſels. To prepare this fermentation, they are not ſcalded, except after having contracted ſome taint; and then, to accelerate it, (the quicker it is the better,) the veſſels are ſometimes rinſed out with ſour butter-milk; in which ſtate, the milk is ready for the churn; and, in conſequence of this treatment, more butter is obtained, and of a better quality, than if the milk was churned ſweet. And the butter-milk, as it is called, after the butter is extracted, inſtead of being given to the hogs, as is generally the practice in many counties, becomes, under this proceſs, an excellent food for man, both wholeſome and pleaſant, as before mentioned. This is the ſort of butter-milk which, it has been remarked, is neceſſary for ſuch labouring poor as live on potatoes.

that

that there be not the leaſt remains of the milk to be obſerved amongſt the butter; a matter highly eſſential to its goodneſs, and its preſervation, if intended for keeping, although too much neglected, on a principle of the ſaving of labour, and gain of weight by the milk remaining in the butter; and yet the amount of labour ſaved, and weight gained, will not be equal to two-pence in the pound *.

Upon the above mode of making butter, the two following experiments were made, in the year 1791, July 28th: two churnings were ordered to be made from the milk of one meal, *viz.* one collection of milk and cream after the uſual manner of collecting milk; and the other of cream only; and which were both treated alike, according to the Lancaſhire method of ſouring the milk, previous to the operation of churning. Fifteen pounds of each kind of butter, prepared and worked as uſual, but with a double portion of ſalt, as the butter was intended to be kept, were put into ſeparate mugs, and covered over with about three half-pints of brine. Theſe mugs ſtood in a cool cellar till Auguſt, 1792; the butter of both mugs was then tried with a butter-

* Query. Does this mean the pound ſterling? two-pence in the pound of butter would be an immenſe ſaving.

ſcoop, and they were both found to be perfectly ſweet and good. The butter was returned to the place whence it was taken, and the hole filled up again with what butter had been taken out with the ſcoop, which forced out the brine that occupied its place during the trial. This was afterwards repeated in Auguſt, 1793, in the ſame manner as before; and the butter was ſtill found perfectly ſweet, and well taſted. About five weeks after the laſt trial, both mugs were broke by the rolling of a caſk; but, as the experiment had ſucceeded ſo well, the ſalt was ordered to be waſhed out; and the butter was made up into pounds, according to the uſual way, and expoſed along with freſh butter in the Liverpool market, and there ſold, after being kept two years and ſeven weeks. If the accident of breaking the mugs had not happened, the butter, after ſo fair a trial of being able to keep, was intended for a preſent to a brother in the Weſt Indies.

XXXIII. *Account of a new Method of bleaching Cotton.* By M. CHAPTAL.

Read at the NATIONAL INSTITUTE.

THE ſucceſs with which M. Berthollet has applied the oxygenated muriatic acid to the bleaching of vegetable ſubſtances, ſeems to have brought that art very nearly to perfection; but this method is not equally advantageous throughout all its branches; beſides which, its execution requires very experienced workmen, that the articles may not be injured by uſing leys in an improper manner, or by employing ſuch as are too ſtrong. We ſhould not, therefore, neglect to make known, and to improve, all the other methods, in order that the manufacturer may chuſe that which appears to him the moſt advantageous. For theſe reaſons, I ſhall now deſcribe a proceſs for bleaching cotton-thread, which is equally ſimple and œconomical.

Fifteen or ſixteen inches above the iron bars of a common fire-place, is to be fixed a copper caldron, of a round ſhape; its depth ſhould be nineteen

teen or twenty inches, and its diameter about four feet ſix inches. The edges of the caldron, which ſhould be ſeven or eight inches wide, are to be turned back, ſo as to reſt upon the brick-work. The remaining part of the furnace is to be of ſtone, built up to the height of ſix or ſeven feet; the width within being about five feet ſix inches. It ſhould be contracted towards the top, ſo as to leave a round opening, of nineteen or twenty inches diameter. This opening is to be occaſionally cloſed by a heavy ſtone, or by a copper cover fitted to it. On the edge of the copper caldron, which may be conſidered as the bottom of this kind of Papin's digeſter, is to be placed a grating, formed of bars of wood, very near each other, that the cotton laid upon them may not paſs through them, and ſufficiently ſtrong to bear the weight of between ſeven and eight hundred pounds of cotton.

The caldron being finiſhed in the manner above deſcribed, the cotton, in hanks, is to be impregnated with a weak ſolution of barilla, rendered cauſtic by quick-lime. This operation is to be performed in a wooden or ſtone trough, in which the cotton ſhould be trod by the feet, covered with wooden ſhoes. When the cotton is thoroughly and equally penetrated by the alkaline ley, it is to be carried to the caldron, and placed upon the wooden grating already ſpoken of. The

ſuperfluous

ſuperfluous liquor runs through the bars of the grating into the caldron, and there forms a ſtratum of liquor, which permits the whole to be heated, without fear of burning either the cotton or the metal.

To make the alkaline ley, a quantity of Alicant barilla, equal to one-tenth of the weight of the cotton intended to be operated upon, is to be employed: in a caldron of the dimenſions above deſcribed, about eight hundred pounds of cotton may be operated upon at one time. The ley made uſe of, is generally of one degree of ſtrength. As ſoon as the cotton is introduced, and properly placed in the caldron, the opening at top muſt be cloſed with its cover; which ſhould fit in ſuch a manner as ſcarcely to leave any vent for the vapours, that they may, when diſengaged by the fire, acquire a great degree of heat, and thereby act powerfully upon the cotton.

Every thing being prepared as is here directed, the fire may be made in the fire-place *; and the ley muſt be kept gently boiling for twenty or thirty hours. The whole may be then

* In the conſtruction of this furnace, I have ſuppoſed that it was intended for burning ſea or pit coal. If wood is to be burnt in it, the dimenſions muſt be varied accordingly. In the latter caſe alſo, the iron bars would be uſeleſs, and the bottom of the furnace would be too high above the ground.

ſuffered

ſuffered to grow cool; the cover may be taken off; the cotton taken out, and expoſed in the field for two or three days, ſupporting it upon bars during the day, and letting it lie upon the graſs during the night. The cotton will be found to have acquired a beautiful whiteneſs; and if, by chance, any of the hanks ſhould appear ſtill to retain any colour, they may be put again into the caldron, and be once more expoſed to the effect of the ley; or they may be left a few days longer in the field. Theſe ſhades in the bleached cotton happen from its not having been, in the firſt operation, completely and equally impregnated with the alkaline ley: or they may ariſe from the cotton having been heaped together too cloſely, in ſome parts, when put into the caldron.

When, during the operation, there is reaſon to ſuppoſe that the whole of the ley is exhauſted by the ebullition, the cover of the caldron muſt be taken off, and the cotton, now become dry, muſt be ſprinkled with a freſh quantity of alkaline ley; otherwiſe it would be in danger of being burnt.

It is eaſy to judge, by computing the value of the ſubſtances, and the time employed in the above operation, how very œconomical this method is, even if we had not a more ſimple and ſure way of determining it, namely, the low price

at

at which cotton is bleached in all the manufactories in which this procefs is employed. In the South of France, where it is pretty generally practifed, cotton is bleached at the rate of about a fhilling for nearly one hundred pounds.

This procefs was brought to us from the Levant, fome time after the introduction of the Adrianople or Turkey red dye. It has been long made ufe of there, though kept fecret from us till this time, and is there called *bleaching by means of vapour.*

I do not know that this method has yet been applied to the bleaching of linen or hempen thread; but it certainly would be very well worth while to try it upon thofe fubftances. It would indeed be neceffary to make ufe of ftronger leys, and to continue the boiling for a longer time than with cotton; and I recommend it to manufacturers, to try this procefs, both with a view of rendering it more general, and of bringing it to greater perfection.

XXXIV. *Obſervations on the Uſe of the actual Cautery, in a Diſeaſe of the Cheſnut Tree.* By M. Chaptal.

FROM THE *BULLETIN DES SCIENCES.*

THE cheſnut tree is, in many parts of France, the principal reſource of the huſbandman: its cultivation is every where carefully attended to, on account of its great utility. This tree lives to a great age, and often grows to a very large ſize; but, unhappily, its texture is very liable to become diſeaſed in various ways. It grows ſoft, falls into duſt, and, by degrees, a cavity is formed, in the very heart of the tree, which increaſes as the decompoſition goes on, ſo that at laſt the trunk of the tree preſents nothing but a bark, which, being too weak to ſupport the weight of the branches, and reſiſt the force of ſtrong winds, cannot prolong, or even maintain, the exiſtence of the tree. It is by means of ſuch diſeaſes and decompoſitions, that we ſee trees, which have been whole ages in coming to their full growth, periſh in the courſe of a very ſhort ſpace of time.

M. Chaptal,

M. Chaptal, in travelling through various parts of the Republic, particularly in Cevennes, and in the department of Allier, observed that the inner part of a great number of chesnut trees was hollowed out, which part appeared burnt upon the surface. Upon enquiring the reason, the inhabitants of the country told him, that this was occasioned by a method they practised to stop a species of caries or rottenness, which would otherwise destroy the whole tree.

When they perceive that this disorder (which is very common, and is the most fatal one to which the chesnut tree is subject) begins to make some progress, and to render the trunk of the tree hollow, they gather fern, and other vegetables that burn freely, and set them on fire, in the cavity itself, letting them burn until the surface is completely charred. This operation, which very seldom destroys the tree, constantly stops the progress of the caries: it is also practised, and with equal success, upon the white oak.

By comparing the effects of the actual cautery upon animal bodies, in disorders similar to the above, we perceive a new analogy between the disorders which affect the organic beings of the two living kingdoms, and between the remedies by which they may be cured.

XXXV. *Experiments and Obſervations on the Properties of Platina. By M.* GUYTON (MORVEAU).

Read at the NATIONAL INSTITUTE.

WE are already far advanced beyond that period when platina was conſidered as a refractory mineral, which could only be made uſe of to adulterate the perfect metals; and which, for that reaſon, was, by the Spaniſh government, forbidden to be extracted from the earth. Chemiſts have deſcribed proceſſes by which it may, with certainty, be diſcovered in all mixtures in which it can be fraudulently introduced. They have alſo deſcribed the method of purifying it, thereby giving it its proper ductility; and many veſſels and inſtruments, that are very valuable on account of its unchangeableneſs, are now made of it, which veſſels, &c. are, for various uſes, in many reſpects preferable even to golden ones.

I ſhall

I ſhall not undertake to deſcribe the ſeries of experiments of which this metal has been the ſubject ſince its diſcovery: they are well known; but thoſe who are beſt acquainted with them, know that they are far from being ſatisfactory; that the art of making this metal ſubſervient to our uſe, is ſtill in its infancy; and that opinions are not entirely agreed reſpecting its moſt eſſential properties. Theſe reaſons have induced me to communicate the reſults of ſome experiments, undertaken with a view of improving this part of the ſcience of mineralogy.

I. *Of the Denſity or ſpecific Gravity of Platina.*

Platina is acknowledged to be the heavieſt of all bodies: its ſpecific gravity exceeds that of gold; but authors differ in their account of the proportion of this exceſs. This may have ariſen, either from their having been deceived by ſome accidental circumſtance; or from having operated upon pieces of platina more or leſs impure; or from having compared it with water at different temperatures.

M. Briſſon reckons the ſpecific gravity of melted platina at 19,5: that of forged platina is eſtimated

eſtimated at 20,236. Count Sickingen carries it as high as 21,061; and M. Chabaneau, in his account of the properties of platina, confirms what he had before advanced, in a work entitled "Elements of Natural Knowledge," printed at Madrid, in 1790, namely, that the ſpecific gravity of pure laminated platina is, to that of water, nearly as 24 to 1.

M. Gregoire having given me a ſpecimen of laminated platina, which had been ſent to him from Spain, by M. Chabaneau, I thought that it would be a favourable opportunity to determine its ſpecific gravity, by comparing it with the ſpecimens of platina which we make uſe of, and conſider to be pure; particularly as the lamina of platina ſent by M. Chabaneau, which undoubtedly had been prepared by himſelf, preſented, by its brilliancy and its high poliſh, a certain teſtimony that it had been completely purified.

I compared it with a piece of wire of platina, of the thickneſs of two millimetres *; which wire I had drawn for the purpoſe of an experiment on coheſion, of which I ſhall ſpeak in the following ſection.

* One millimetre is equal to 0,0393 inch.

The

The lamina received from M. Chabaneau weighed 2,902 grammes *: it loſt in diſtilled water (of the temperature of 54½ degrees, Fahrenheit,) 0,1393 gramme; which gives a ſpecific gravity of 20,833.

The wire of platina weighed 4,9095 grammes: it loſt in diſtilled water 0,2355 gramme. This gives a ſpecific gravity of 20,847; therefore, according to this experiment, the platina uſed in France, not only equals in denſity that ſent by M. Chabaneau, but ſurpaſſes it by $\frac{68}{100000}$.

I ought to obſerve, that the platina wire here ſpoken of, had been very much hardened, firſt in drawing, and afterwards by being held in the vices made uſe of in the experiment upon cohesion.

It is clear that the above valuation comes very near to that of Count Sickingen; but it is difficult to conceive why that of M. Chabaneau differs from it by nearly $\frac{1}{5}$; ſince, in eſtimating the ſpecific gravity of pure gold, (or gold of 24 carats,) he agrees with the philoſophers of every other country. There cannot be a doubt but that he operated in the ſame manner, and with the ſame inſtruments; conſequently, the la-

* One gramme is equal to 16,935 grains, Troy.

mina

mina which he ſent, had not the ſame degree of purity and hardneſs as the platina which gave him the high degree of ſpecific gravity above mentioned.

II. *Of the tenacity or cohesion of Platina.*

The form in which the parts of a metal are united together, ſerves not only to characteriſe the ſubſtances of this claſs by very marked diſtinctions, but this property is alſo one of the moſt uſeful to be known, in order to determine their value, with reſpect to the various uſes to which they may be applied.

I do not know that any one has employed himſelf in this enquiry, with reſpect to platina, except Count Sickingen *. It reſults from his experiments, that a wire of platina 0,3 lines in diameter, and two feet in length, ſupported a weight of 28 pounds, 7 ounces, 3 gros, $65\frac{5}{7}$ grains, = 262361,714 grains; whereas, a gold wire, of the ſame dimenſions, ſupported only 16 pounds, 9 ounces, 4 gros, 60 grains, = 152988 grains.

* See his work entitled *Verſuch uber die Platina.* Mannheim, 1782.

I drew

I drew a piece of wire, of pure platina, exactly 2 millimetres in diameter, and 11,672 centimetres * in length. It weighed, when finiſhed, 8,372 grammes.

I fixed one end of the wire, defended by two pieces of ſmooth copper, in a ſtrong vice; and, having faſtened the other (by means of a hand-vice) to the arm of a balance, I gradually loaded the oppoſite ſcale.

The charge already amounted to 118,850 kilogrammes †, when one of the extremities of the wire eſcaped from the vice.

At a ſecond trial, however, it broke when the ſcale was charged with only 116,87 kilogrammes. The part where the wire broke was very near the vice, and had the appearance of having been twiſted.

Laſtly, in a third experiment, the ſame wire ſupported 124,69 kilogrammes, before it broke.

It muſt be remarked, that in this laſt experiment, the coheſion of platina appears to be ſtronger than it was found to be by Count Sickingen; ſince, by comparing the reſults, ac-

* One centimetre is equal to 0,393 inches.

† One kilogramme is equal to 2 lbs. 11 oz. 5 dwts. 15 grains, Troy.

cording to the ſquares of the diameters of the wires made uſe of, a wire of two millimetres in thickneſs ought, agreably to his obſervations, to have ſupported only 116,954 kilogrammes.

Muſchenbroek's table of the tenacity of metals, is arranged in the following order, *viz.* iron, ſilver, gold, copper, tin, &c.; but Count Sickingen's experiments, which appear to have been made with great accuracy, place copper immediately after iron, and before ſilver. According to them, platina will occupy the third place, that is to ſay, it will ſtand before gold, and even before ſilver.

Here follows a table of the tenacity of the different metals, expreſſed in the terms of our new weights and meaſures; in which table I have not heſitated to ſubſtitute the proportion given by my experiment upon platina, rather than to take that which would be obtained by calculation from Count Sickingen's obſervations; becauſe, in the preſent caſe, we are not ſeeking for a mean proportion, but for an extreme one; which proportion is conſtantly diminiſhed by accidents, and againſt which, the length of the wire cannot fail to operate in an unfavourable manner.

An

	Kilogrammes.
An iron wire, two millimetres in diameter, ſupports, before it breaks, .	249,649
A copper wire, of the ſame dimenſions, ſupports, ...	137,399
One of platina,.	124,690
—— of ſilver, ...	85,062
—— of gold, ...	68,216

II. *Of the adheſion of Platina to Mercury.*

I publiſhed, ſome years ago, a table of the adheſion of mercury to different metals *, in which I ſhewed that it correſponded with the affinities obſerved in the formation and decompoſition of amalgams. It appeared to me of importance to bring platina into this table; particularly, becauſe it is generally ſuppoſed that mercury does not adhere to platina more than to iron, and becauſe this opinion has ſome appearance of being not wholly unfounded.

I turned and faſhioned, in a lathe, a round plate of pure laminated platina, of twelve lines in diameter, weighing, when finiſhed, 10,2371

* See my Elements of Chemiſtry. Dijon, 1777. Alſo *Encyclopedie Methodique*, article *Adheſion.*

grammes. It was then ſuſpended to the arm of a balance, and, when the equilibrium was reſtored by loading the oppoſite ſcale, I lowered the arm with the platina, ſo as to bring the latter into contact with ſome mercury which was placed underneath, in a ſaucer.

At the firſt trial, the platina was detached from the mercury by the addition of 58,91 decigrammes * in the oppoſite ſcale: it did not bring off with it the ſmalleſt particle of mercury.

At a ſecond trial, it ſupported 77,95 decigrammes; and came off, as before, without bringing away any of the mercury.

Having put it into contact with the mercury a third time, and added the weights in the oppoſite ſcale ſo gradually that the operation laſted ſeveral days, the charge was ſucceſſively increaſed to 149,80 decigrammes, before the ſeparation took place. The above quantity may therefore be conſidered as expreſſing the force of adheſion between theſe two metals, (within the limits of the given ſurfaces,) when the efforts which tend to ſeparate them is exactly perpendicular to the centre of the plate of platina, and when the contact (which, in this caſe, appears to grow ſtronger

* One decigramme is equal to 1,693 grain.

by

by time) is become as perfect as the respective aggregation of the two substances permits it to be.

It may be supposed, that this time also the platina was not affected by the mercury; but, towards the end of the operation, a border of mercury, which indeed appeared rather roundish, might be seen rising around the plate.

The lower surface of the plate had even carried away, in separating itself, ten or twelve very small globules of mercury, some of which, that projected the least, formed a real drop, of the nature of those which penetrate the bodies to which they adhere.

The plate of platina having been weighed in this state, and again after having been heated to a white heat, the difference was found not to amount to 7 milligrammes.

The result of this experiment fixes the place of platina (in the table of adhesion of metals to mercury) between bismuth and zinc.

The property of platina, of supporting the greatest degree of heat without becoming oxidated, and even without losing its polish, suggested to me the idea of trying whether the adhesion of platina to mercury would not be increased by heating the platina to a white heat,

and in that ſtate applying it to the mercury, as the coheſion of the particles of the platina to each other would then naturally be more weak: I found, however, that when the platina was in this ſtate, I could not charge the oppoſite ſcale with ſo much as 58 decigrammes (as in the firſt experiment) before the ſeparation took place. This I think ought perhaps to be attributed to the impoſſibility of cleaning the ſurface of the platina, before its application to the mercury; for the diminution of the power of coheſion produced, in other reſpects, a very ſenſible difference, namely, that the platina appeared to be acted upon by the mercury, and ſome drops adhered to it; they, however, ſeparated from it pretty eaſily.

TO BE CONCLUDED IN OUR NEXT.

XXXVI.

XXXVI. *Liſt of Patents for Inventions, &c.*

(Continued from Page 144.)

John Foster, of Oxford-ſtreet, in the pariſh of St. Mary-le-bone, in the county of Middleſex, Breeches-maker; for a new-invented bracer or ſling, acting by means of a certain ſpring or ſprings made of ſteel, calculated for the better and more convenient ſuſpending and keeping up breeches, pantaloons, or drawers. Dated December 2, 1799.

John Palmer, of Maxſtock, in the county of Warwick, Gentleman; for improvements in machinery for clearing grain from the ear or ſtalk, and for breaking or cutting the ſtraw into provender for cattle, and other uſeful purpoſes. Dated December 6, 1799.

William Reynolds, of Ketley, in the pariſh of Willington, in the county of Salop, Iron-maſter; for a method of preparing iron for the converſion thereof into ſteel. Dated December 6, 1799.

John

JOHN FREDERIC CHABANNES, of Welbeck-ſtreet, in the pariſh of St. Mary-le-bone, in the county of Middleſex, Eſquire; for a machine for ſeparating coals, and a compoſition for making ſmall coals into cakes or bricks, to be uſed for fuel. Dated December 16, 1799.

EDWARD LUDLOW, of Walworth, in the county of Surrey, and ANN WILCOX, of the city of London; for their new-invented playing-cards, to be named *Brilliant new-invented Knight's Cards.* Dated December 20, 1799.

WILLIAM LOOSEMORE, of the pariſh of St. Luke, Old-ſtreet, in the county of Middleſex, Factor; for a method of making and manufacturing certain cloth, for general uſes and purpoſes. Dated December 20, 1799.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER LXX.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

XXXVII. *Specification of the Patent granted to Mr.* ROBERT HINDMARSH, *of Walworth, in the County of Surrey, Printer; for a Method of applying an elementary or phyſical Power to blaſt Furnaces, and for all other Works where Power is required.*

Dated Nov. 27, 1798.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that in compliance with the ſaid proviſo, I the ſaid Robert Hindmarſh do hereby declare, that my ſaid invention is de-

fcribed in manner following: It is well known, that the preffure of water and other fluid bodies, in any containing veffel, is in proportion to the altitude of the fluid, without any regard to the quantity. Thus, if a cylindrical or otherwife figured veffel, whofe bottom, for example, is 3 feet in diameter, have a clofe top, with a tube 20 feet high fitted into it, and the veffel and tube, when full, contain only one pint of water, which weighs only 1 lb. yet the preffure of this water upon the bottom of the faid veffel, will be equal to 10737 lb. which is the fame as it would be, were the veffel a perfect cylinder, 20 feet high, and 3 feet in diameter throughout, and filled with water; and this preffure is exerted, not only in a downward direction upon the bottom of the veffel, but, by the peculiar property of fluids, is alfo exerted, with the fame power at equal depths, upwards, laterally, and in all directions. It is of no confequence whether the tube be perpendicular or inclined; the preffure being always in proportion to the abfolute height of the fluid, and the bafe againft which it preffes, whatever the form of the veffel or tube may be. This wonderful property of fluid bodies is called the *hydroftatic paradox*; and, though long known to fcientific men, has hitherto been thought incapable of being applied to machinery with any mechanical

mechanical advantage. But, having discovered a method of bringing it into effect, it is in the *application* thereof, under an indefinite variety of forms, that the principle of my said invention consists.

Suppose a stream of water to run from the side of a hill, or other elevated situation, into a tube communicating with the top and bottom of a cylinder, suppose 3 feet in diameter, in which is a moveable piston, water-tight, with a rod working through a stuffing-box, also water-tight. If, by means of a cock or valve, the communication be opened for the water to pass into the cylinder below the piston, while the communication with the part above the piston is cut off by another cock or valve, the water will force the piston up; and, by shutting the cock or valve below, and opening that above, the piston will be forced down again. (N. B. When the piston descends, the water below it passes off through a pipe at the bottom of the cylinder; and, when the piston ascends, the water above it passes off through a pipe at the top of the cylinder, the cocks or valves of which pipes are previously opened for that purpose.) And thus the piston is worked alternately upward and downward, with a power equal to 5368 lb. if the water in the tube be 10 feet high; with a power equal to 10737 lb. if it

be 20 feet high; with a power equal to 21475 lb. if it be 40 feet high; and, with a power equal to 53689 lb. if it be 100 feet high; the power increafing in arithmetical proportion, according to the altitude of the water in the tube; and in geometrical proportion, according to the diameter or furface of the bafe againft which the water preffes. On this principle, the pifton-rod, by being connected in the ufual way with machinery of any kind, will act upon it with great advantage; being applicable to blaft furnaces, to mills of every defcription, to cranes for raifing and lowering goods, &c. to pumps, preffes, and all other machinery where power is required.

The above defcription is given on a fuppofition that the water, which works the pifton of the cylinder, runs away either wholly or partially in wafte. But the following defcription fhews how the fame water may be returned back, fo as to work the machine over and over again, and, confequently, how the principle of this invention may be applied in all fituations, even where there is no natural fall of water. In addition to the before-mentioned cylinder, let there be provided a fecond cylinder, fuppofe 4 feet in diameter, with a pifton, water-tight, the rod of which communicates motion to any other machinery: upon this pifton let there be placed weights equal to

20282 lb.

20282 lb. The piston being down, with this great weight upon it, is raised in the following manner. At the bottom of this second cylinder a tube is inserted, the lower part of which may be of iron, or other strong materials, and the rest of leather, for the convenience of bending. The upper end of this tube terminates in a large cup or reservoir, capable of holding as much water as will fill the cylinder at the bottom of the tube; and the cup, so fitted to the end of the tube, is placed at the top of a wheel, which we will suppose to be 20 feet or more above the cylinder, and of a diameter sufficient to answer the under-mentioned purpose. Pour water into the cup, and it will descend through the tube into the cylinder below the piston, which will be immediately forced up, (say 2, 3, or more feet,) together with the weight of 20282 lb. upon it. The piston being elevated, the cylinder is now full of water, as is the tube up to the bottom of the cup, which itself is empty. In order to discharge the water from this second cylinder, and permit the piston to be again depressed, the wheel, by a connecting rod, or other medium passing between it and the piston of the first cylinder while at work, is caused to make half a revolution; by which motion, the empty cup, together with the upper end of the tube, is lowered to the

bottom

bottom of the wheel; and, consequently, the pressure of the water, against the under part of the piston of the second cylinder, is so far taken off, that the great weight of 20282 lb. upon the piston, presses it downward, and urges the water out of the cylinder, through the tube into the cup; which cup is again elevated to its former position by another half revolution of the wheel, effected as before by the piston-rod of the first cylinder; and so on, alternately, without any loss of water in the second cylinder. The waste water from the first cylinder may run into a reservoir, and be raised thence to its former situation, by the action of the piston in the second cylinder, working a pump or other engine, besides having sufficient power to drive other machinery. The elevation and depression of the cup and upper end of the tube may also be effected in a variety of other ways, as by a man or a horse working it; but the method here described is sufficient to explain *this part* of the principle of my invention, which consists in applying and taking off, in certain required proportions, the pressure of water in the cylinder, by alternately elevating and depressing the upper end of the tube, on the altitude of which fall of water depends the momentum of the power produced. Or, the same effect may be produced by substi-

tuting

tuting a heavy rolling-weight, ſuppoſe of 9 tons, inſtead of the ſecond cylinder with its apparatus: this weight, by means of the piſton-rod of the firſt cylinder, is to be made to roll withinſide the arch of a large wheel, like that of a crane, backwards and forwards, over the centre of a balance, the frame-work of which is ſo contrived as to keep the rolling weight always on the ſame level, while the balance moves freely up and down.

In the above deſcriptions, no allowance is made for the friction of the piſtons in the two cylinders, as is uſual in other machines; for, having invented a method of working the piſtons without any friction at all, I apply the power thereby ſaved to the actual working of the machinery itſelf; and, therefore, the ſaid method of working without friction is conſidered as a part of my ſaid invention, and is deſcribed as follows. Let the piſton be fitted to the cylinder, but neither air nor water tight, ſo that it may ſlide up and down without any friction. The upper and under part of the piſton muſt be lined with leather, or any other ſubſtance that is water-tight; which leather, or other ſubſtance, muſt be continued from the piſton, when elevated, down to the bottom of the cylinder, and, when depreſſed, to the top of the cylinder, in the form of a bag on each ſide of

of the piſton: the extreme ends of both bags muſt be well faſtened to the cylinder, leaving the ſides looſe, and free to fall in folds, during the aſcent and deſcent of the piſton. Now, when the water ruſhes into either end of the cylinder, it enters the cavity of one of theſe bags, and, preſſing againſt the piſton, endeavours indeed to force the bag through the inſenſible ſpace between the edge of the piſton and the cylinder; but, it being impoſſible for the bag to paſs that way, without being doubled and alſo incloſing a portion of the water, and the piſton being fitted to the cylinder ſo cloſely as not to admit even the ſubſtance of the bag ſingly, much leſs doubly and with a portion of water incloſed, the conſequence is, that the piſton riſes and falls without any friction at all; and yet the water is prevented from paſſing between the piſton and cylinder. Thus, the power which is uſually loſt by the friction of the piſton, is here completely ſaved, without detriment to the work; and the phyſical operation of the water, or other ponderous ſubſtance, is permitted to have its full effect. In witneſs whereof, &c.

XXXVIII.

XXXVIII. *Specification of the Patent granted to Mr.* JAMES BURNS, *of the City of Glafgow, in the County of Lanark, Builder; for his Invention of certain Improvements applicable to Fire-Grates, Stoves, Furnaces, and Chimneys, by which a greater Quantity of Heat may be obtained from a given Quantity of Fuel, and Rooms and Halls of every Defcription be heated more fpeedily and effectually, than by the Methods now in ufe; while at the fame Time they are calculated, in a great Degree, to prevent thofe lamentable Accidents which fo frequently arife from Women's and Children's Clothes catching fire, and to give a Degree of Cleanlinefs which cannot be attained where Grates and Stoves of the common Conftructions are employed.*

WITH TWO PLATES.

Dated Nov. 23, 1799.

TO all to whom thefe prefents fhall come, &c. NOW KNOW YE, that I the faid James Burns, in compliance with the faid provifo, do hereby declare,

declare, that the nature of my ſaid invention, and the manner in which the ſame is to be performed, is particularly deſcribed and aſcertained in the reſpective plan, elevation, and ſections, hereunto annexed, and the following deſcription thereof; that is to ſay: The intention of my ſaid invention is, to prevent the heat generated and thrown out into any room or apartment by combuſtion, from being unneceſſarily waſted by the air of ſuch room or apartment being made to maintain the combuſtion of the fuel in the grate, as is uſual in the ſtoves or grates on the common conſtruction; where all the air that goes to maintain the combuſtion is furniſhed from the air in the room, the waſte of which is ſupplied by the exterior cold air, which comes pouring into the room at the bottom of the doors, or by the ſides of the windows, and thereby undoes a great part of the effect that otherwiſe would be produced by the fire. To accompliſh this intention, the air that maintains the fire in the grates or ſtoves made with my improvements, or in other grates or ſtoves to which my improvements may be applied, ſhould be brought through a tube, (which I ſhall call the air-tube,) from the outſide of the houſe; or be made to paſs, from the outſide of the houſe, between two of the joiſts, where the floors and cielings are cloſe enough to allow this, ſo as to be brought to the bottom bars of the grate, without

without having any communication with the interior air of the room; while, at the ſame time, the grates and parts connected with them ſhould be ſo conſtructed, that when the fire is not wiſhed to be ſupplied with cold air from the outſide of the houſe, the paſſage may be ſhut more or leſs perfectly, by means of a valve, a ſmall door, a cock, or any ſimilar contrivance. When convenience does not admit of the air-tube being carried to the outſide of the houſe, if carried to a cellar, larder, ſtair-caſe, or any lumber-room, the ſame end will be gained; with this farther advantage, that ſuch cellar, larder, ſtair-caſe, or lumber-room, will thereby be well ventilated, and prevented from acquiring, or retaining, any unhealthy or diſagreeable ſmells. From the foregoing ſhort deſcription of this part of my invention, it will be eaſily ſeen, that the end may be gained by many various modes of conſtruction, according to fancy or circumſtances; but I ſhall give a deſcription of one of my grates, conſtructed with ſuch improvements, in as plain and intelligible a manner as poſſible. The principle, however, of ſupplying the fire with air from without the room or apartment, ſo as to prevent the warm air of the room from being drawn to the fire-place and hurried up the chimney, while, at the ſame time, all the advantage of open

grates may be enjoyed, is hereby ſpecified; as my invention for the form of the grates or ſtoves may be varied indefinitely.

Fig. 1. (Plate X.) repreſents a grate of the improved conſtruction; and Fig. 2. (Plate XI.) is a ſection of it.

The air that maintains the combuſtion is ſupplied through the pipe or tube A, (Fig. 2, and Fig. 4,) or from between the under cieling and floor, as before mentioned; from which, it paſſes up by the back, or ſide, of a drawer B, Fig. 4, according as it is moſt convenient to bring it up by the one or the other; the back however is preferred, where convenience admits of it. The front of this drawer, in its place, is ſeen in Fig. 1, at C. The intention of this drawer is, to receive the aſhes that fall from the bottom bars of the grate; ſections of which are repreſented at D D, Fig. 2. The aſhes, as they fall from the bars, ſtrike againſt the ſides of the internal cavity E, and then are carried by their own gravity through the narrow part F, and fall into the drawer. This part of the conſtruction may be eaſily underſtood, by conceiving it to be a hollow vaſe, as it actually is, with a drawer in its pedeſtal or baſement, and having a grate over it, on which the fire reſts. The valve, door, cock, or other contrivance by which the external air is admitted, or excluded, may be made in

many

many various ways; and may be either in the neck F of the vaſe; or in the air-tube; or in the drawer B or C; or, which I prefer, in the cavity behind the drawer; the pedeſtal or baſement of the vaſe being made large enough to admit of ſuch cavity. Various conſtructions may be reſorted to; but that repreſented in Fig. 3. (which is a ground-plan of a proper chimney for ſuch a grate, and in which a bird's-eye view of one half of the grate may be ſeen in its place, while the other half repreſents a horizontal ſection of the baſement or pedeſtal, which is ſuppoſed to be open, ſhewing the drawer in its place, with the cavity behind it,) will be found to anſwer every purpoſe. The cavity G is ſeparated from the place in which the drawer is put, by a partition (beſt made of plate or caſt iron) paſſing from H to H, in which there is an opening I, with a cover K. To the cover K is attached a ſmall bar L, worked by another ſhorter bar M, to which it is attached by any ſimple joint. The bar M is faſtened into an upright pivot, the top of which comes up through the pedeſtal, at one of its corners, or any other convenient ſpot, and is furniſhed with a button, to be laid hold of by the finger and thumb, or with a top fitted to a key, by the turning of which the cover K is made to ſhut or open the aperture I, and conſequently to prevent,

prevent, or facilitate, the paſſage of the air from the hole at G, which repreſents the internal mouth of the air-tube; the other end of which is on the outſide of the houſe, or in any cellar or other apartment, as before deſcribed. When the air has paſſed through the aperture I, it finds no difficulty in paſſing on to the bottom of the grate, that back or ſide of the drawer next which the aperture is, being made low, to allow it to flow in freely. The grate, and its internal cavity E, may be of any convenient form; but circular or elliptical will anſwer beſt, eſpecially when another improvement included in the preſent patent is intended to be applied, and which ſhall be immediately deſcribed; but the improved fire-grate already deſcribed may be uſed either with or without the other improvement juſt alluded to, which is, a glaſs or a wire-work fence or ſcreen, to prevent thoſe dreadful accidents which ſo frequently occur, of ladies' or children's clothes being ſet on fire by ſparks from the grate. Where this ſafeguard, fence, or ſcreen, is wiſhed to be applied, the inſide of the chimney where the grate is to ſtand had beſt be a ſemi-cylinder, or nearly ſo, (as repreſented in Fig. 3.) with a lining or cover *a a a*, beſt made of metal, at ſuch a diſtance from the ſemi-cylindrical wall N N N N, as to give ſufficient room for allowing the

ſafeguard

ſafeguard or fence to be ſlid round into it, when the fire is wiſhed to be left open, when freſh fuel is to be added, or when the drawer with the aſhes is to be removed. The fence is a frame-work of metal; which, when filled up with glaſs, or with wire-work, forms a portion of a cylinder, anſwerable to the curvature of the ſpace between the back of the chimney and the lining above mentioned, made in one or more pieces, and moving in a circular groove *b b b*, in or upon the hearth, which ſerves to conduct it into its place behind the grate, when the fire-place is wanted to be left open, as before mentioned. The top of the front of the opening of the chimney O, Fig. 4, projects in a circular form, or is furniſhed with an added projection, made of metal, marble, or any other fit material; but, in either caſe, the projection is furniſhed with a circular groove on its under ſurface, of the ſame radius with the one in or planted on the hearth, for the purpoſe of receiving the upper part of the frame-work of the fence or ſafeguard; which frame-work may be filled up with glaſs, either plain or bent, and either colourleſs or coloured, or ſtained, or painted, with figures or deſigns of any kind. By this means, compleat ſafety is obtained againſt any ſuch accidents as have been alluded to; while, at the ſame time, the comfort ariſing from the view

of

of a chearful fire is not prevented by the interposition of any opaque body. But, for nurſeries or the like, where convenience and ſafety is more the object than elegance or luxury, the frame-work may be filled up with wire-work. The fence may be ſeen in its place, in the drawing, at P. Though I have ſtated, that the frame-work of the fence or ſafeguard juſt deſcribed moved in a circular groove at top and bottom, I do not mean to ſay that no other conſtruction will anſwer; on the contrary, the proceſs may be reverſed, and, inſtead of ſuch grooves at top and bottom, for the fence to move in, the fence itſelf may be furniſhed with a groove at its top and one at its bottom, to receive any projecting piece of metal, or other ſubſtance, of a proper curvature; or its bottom groove may receive the upper edge of the fender, which, being made to a proper curve, and properly adjuſted and kept in its place, will anſwer the ſame end. But, whichever of theſe ways be followed, or whatever other method of conſtruction, (for it may eaſily be varied to anſwer circumſtances,) rollers or caſtors ſhould be provided at the lower part of the fence, to make it move with greater eaſe, either to the front of the grate, or into the ſpace between the back of the chimney and the lining above mentioned. Where either the glaſs, or the wire-work

frame,

frame, or both of them, are meant to be applied to ſquare or rectangular chimneys, without the trouble of giving them a ſemi-cylindrical form, the lining to receive the fence or fences may be introduced at the ſides or jambs of ſuch chimneys; or the fence may be made to riſe, by means of pulleys, into the wall above the opening; or be ſlid ſideways into the walls, at the ſides of the opening. Theſe improvements may be introduced either together or ſingly, and may be applied to many of the grates now in common uſe. Beſides the advantages already pointed out as connected with them, they poſſeſs alſo the following: any room or apartment may be heated by their means, with a much ſmaller quantity of fuel than by any other method yet in uſe; at the ſame time, the advantage of ſeeing the fire is not loſt, as in cloſe ſtoves, for theſe grates have ſide as well as bottom bars, which allow the radiant heat and light to be thrown out into the room, without any impediment; and, in fact, large rooms, halls, and the like, which by the uſual methods can hardly be warmed, or made at all comfortable in cold weather, may, by means of theſe improvements, be heated as effectually as the ſmalleſt apartment; for, when their full effect is wanted to be procured, it is only neceſſary to keep the fence in its receſs, that even that portion of heat which would be

kept back by the interpofed glafs, or wire-work, may be thrown out into the room, and perform its office. They are alfo, an effectual cure for fmoky chimneys; which not only caufe great wafte and deftruction of good furniture, but many difeafes to the inhabitants of houfes plagued with that evil. They caufe a clean fire-fide to be eafily commanded at all times; as hardly any of the duft or afhes fall through the fide-bars; almoft the whole paffing through the bottom-bars, down into the drawer. And any fire lighted in fuch improved grates, burns up and becomes lively in a few minutes, without the aid of bellows, and that watchful care which common grates or ftoves require. The principles of the improvements which I have thus briefly defcribed, may be applied, in many various ways, either to new grates, or to thofe already in ufe. In witnefs whereof, &c.

XXXIX.

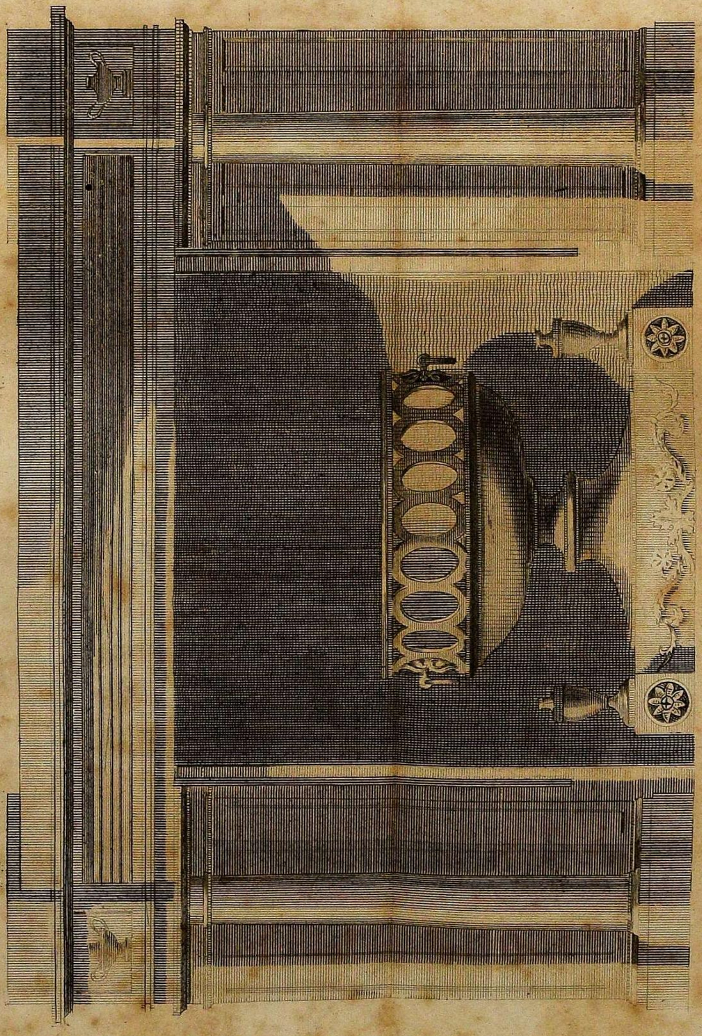


Fig. 1.

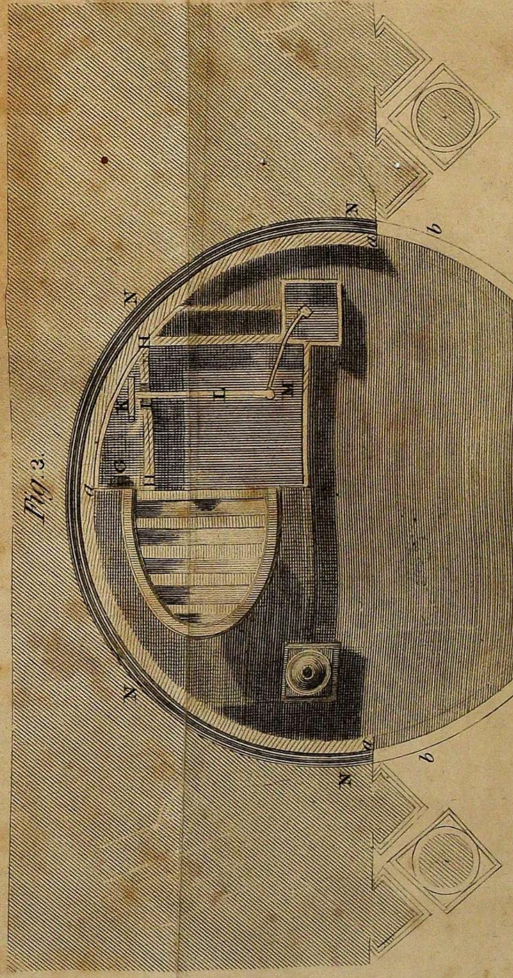


Fig. 3.

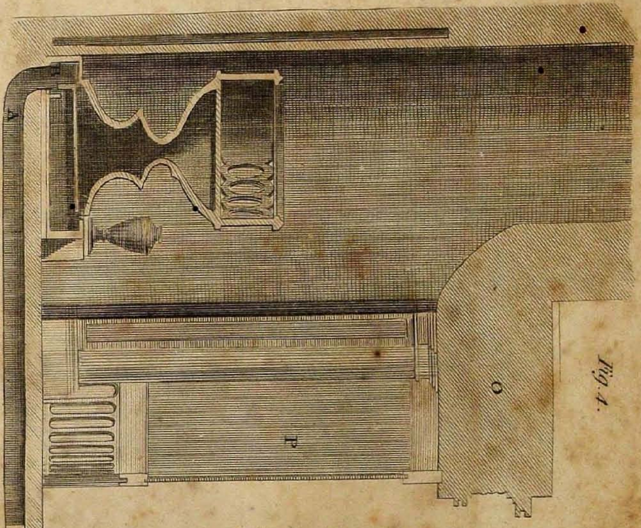


Fig. 4.

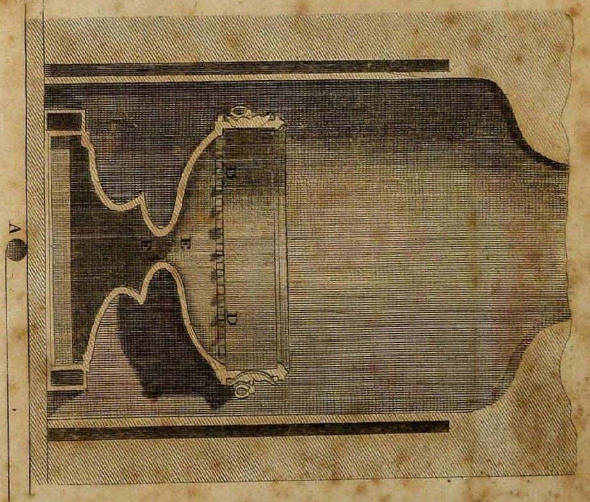


Fig. 2.

XXXIX. *Specification of the Patent granted to Mr.* George Dodson, *of Blackfriars-Road, in the Parish of Christ Church, in the County of Surrey, Cabinet-maker, and Mr.* John Skidmore, *of High-Holborn, in the County of Middlesex, Iron-founder; for a Method of making and casting, with Cast-Iron, Brass, or mixed Metal, Naves or Stocks for all Sorts of Wheels, to be used for all Sorts of Carriages, as well for Pleasure as for Burden.*

WITH A PLATE.

Dated August 8, 1799.

TO all to whom these presents shall come, &c. Now know ye, that in pursuance of the said letters patent, and in obedience to the above-mentioned proviso therein contained, we the said George Dodson and John Skidmore do hereby disclose, discover, and describe, our said invention, in manner and form following; that is to say: The patterns to be turned the size and manner of the outside of the nave or stock, when

 cast;

cast; which patterns may be all in one piece, but are preferable in three, for convenience of moulding. The patterns to have core-stays in the centre piece, to lay in the cores, to make the mortise-holes for the spokes, as described in Figs. No. 1, 2, and 3, (see Plate XII.) in the drawings in the margin of these presents; and, when moulded, an iron spindle, made perfectly round, smoothed and greased over, to be fixed down the centre of the mould, in a flask, and to go through Figs. 1, 2, and 3; which, when the flask is closed, and the metal poured in, will make a nave or stock in one piece, with a perfect cylinder, in the common way of pipe-boxes. A much better method of doing them is, to make hollow cavities in the internal part of the nave, stock, or box, to hold as much oil as possible, that carriages may be supplied with oil as long as they can; to accomplish which, we make a core pattern, split and pegged together, whereby to bring them exactly in their places, then turned to the greatest nicety, the size of the axletree-arm, leaving swells or lumps on it, where we want the hollow cavities or chambers for the oil in the internal parts; then part them, laying one flat in a little box for that purpose, and, after greasing or oiling the pattern, pour on it fresh wetted

plaster

plaſter of Paris, which cloſes this half core pattern exactly cloſe in every part; and, when ſet hard, we turn it over, and put the other half of the core mould or pattern on the former one, (already on the plaſter of Paris,) by the pegs and holes, it comes exactly to its former place in which it was turned, and then put another ſmall box, or frame, over that; and, after greaſing or oiling the face of the already caſt half, and the other half pattern, we then pour that box full of wet plaſter of Paris, and, when dried hard, part them, and take out the wooden core-patterns, which leaves the exact reverſe of the turned core patterns. Then, caſt from theſe plaſter of Paris patterns a pair of core-moulds, in iron, braſs, or other metal, in which we make the core of ſand, or loom, exact, as deſcribed in Fig. 4, in the ſaid drawing; this core is put into a flaſk, as deſcribed by the iron ſpindle, through the Figs. 1, 2, and 3, in the ſaid drawing; and, when the metal is poured round it in the flaſk, it makes the hollow reſervoir for the oil to ſupply the axletree and bearings, as deſcribed in the hollow of letter B, alſo in the ſaid drawing; by which means, we can make proviſion for more than treble the quantity of oil of any other nave or box ever in uſe; and, to add to the great utility of this article, both for uſe and beauty, we can ſcrew up the end of

of it with a cap, made of ſilver, ſilver plated, braſs, iron, or other metal, as the value of the carriage may deſerve, or the purchaſer require, and which, being made air-tight, keeps out dirt, and contains the oil. The ſcrew in the nave or ſtock, to receive this cap, may be turned in a lathe or engine, in the uſual way of ſcrewing; and, when turned perfectly true and clean in the inſide, it may be caſe-hardened, and poliſhed to the greateſt perfection; and, in the arm of the axletree, turned, if required, to fit exactly; and, when put together, and filled with oil, they muſt work as ſmooth and true as any wheel ever made uſe of. A much quicker method of making the ſcrews to receive the caps, to incloſe the end of the nave or box, is, by having ſcrew-cores of ſand, or loom, made by ſcrew-core boxes; or by having ſcrew-dies made of wrought or caſt iron, and turned with a ſcrew in the inſide of the die, and then moulded with the patterns, and left in the ſand, for the metal to run into them; when caſt, the die or core will ſcrew off, and leave a thread or ſcrew, very ſufficient to receive the cap as aforeſaid, and will be an expeditious and cheap way of making them. Some people may imagine, that conſtant uſe will wear the bearings away, and make them too wide for the axletree; but, the bearings are ſo very hard and ſmooth, that

that they will wear a great length of time; and a remedy is provided againſt ſuch doubts, for thoſe who wiſh to have them that way, by making them ſo much wider as to receive boxes all through, if required, with holes through the middle part of ſuch box, to permit the oil to paſs through, from the reſervoirs, into the inſide of the ſaid box; though it is much better that there ſhould be a box at each end, the length of the bearings; ſuch boxes to be made of iron, ſteel, braſs, or any other mixed metal fit for the purpoſe; which boxes may be taken out, and replaced with new ones, in a few minutes. By this principle, the nave or ſtock muſt endure for generations, nay, it may be ſuppoſed, to the end of time; the core, and box for which, is deſcribed by Fig. 5, and Box 6, in the ſaid drawing. To prevent the trouble of taking the wheels off when they want oil, a hole can be caſt or drilled through, from the outer part of the back of the nave or ſtock, into the internal part; and a ſcrew may be made to fit it; or it may be corked up, and, by taking out the ſcrew or cork, the reſervoir may be ſupplied with oil through a ſmall funnel, without the leaſt inconvenience.

Letters A E and F, in the ſaid drawing, ſhew a nave or ſtock finiſhed, ready for the wheelwright.

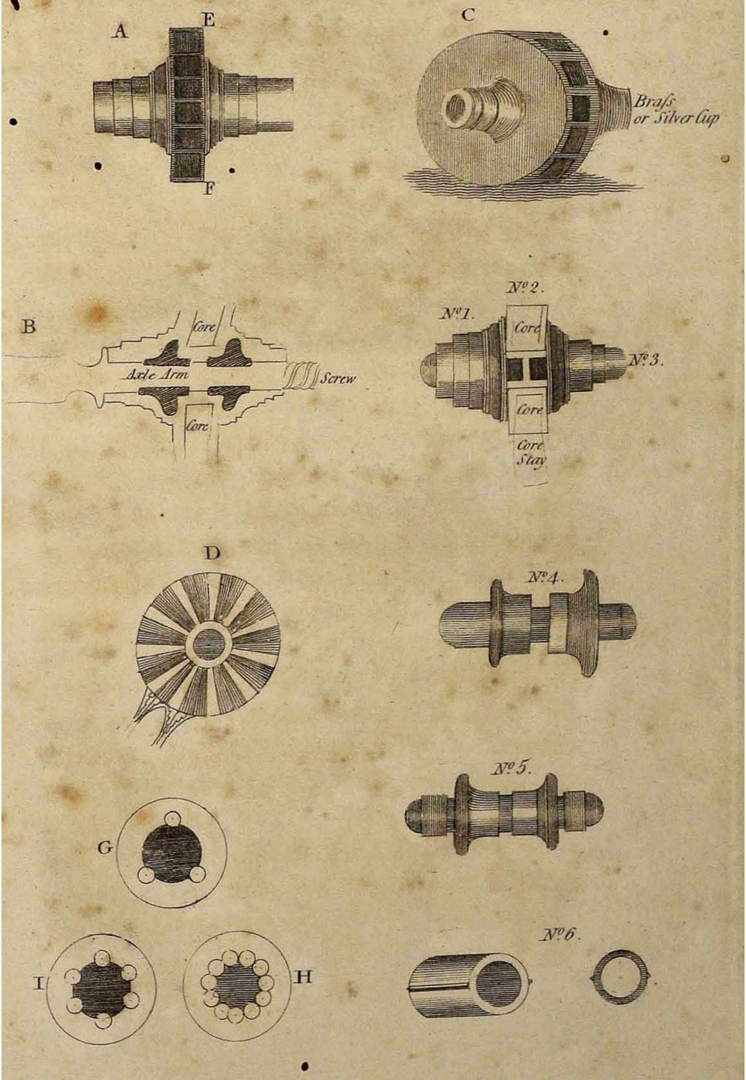
Letter

Letter B, ſhews the ſection of the nave down the middle, longways, in which the axletree arm goes through, and ſhews the reſervoir for oil, where it is blacked.

C, ſhews the nave, ſideways, when finiſhed.

D, the ſection through all the mortiſes for the ſpokes, and axletree arm, the ſame as if cut down from E to F.

Theſe naves or ſtocks are naturally the moſt eligible of any other to receive various principles of friction wheels and rollers; part of which is deſcribed by letters G, H, and I, to have three, ſix, or more rollers, each two inches long, more or leſs, put into holes caſt into the end of the nave or ſtock, of the ſame depth as the rollers, and cleaned out well, that the rollers may work eaſy as the wheel goes round. In witneſs whereof, &c.


A
E
F
C
Brafs
or Silver Cup
B
Core
Axle Arm
Screw
Core
No. 2.
No. 1.
Core
No. 3.
Core
Core
Stay
D
No. 4.
No. 5.
G
I
H
No. 6.

XL. *Specification of the Patent granted to Mr.* HENRY CLAY, *of Birmingham, in the County of Warwick, Japanner; for a new Method of manufacturing Buttons, of a Material not before used for that Purpose.*

Dated February 23, 1790.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Henry Clay do hereby declare, that my said invention of a new method of manufacturing buttons, of a material not before used for that purpose, is described in manner following; that is to say: First, I turn, grind, cut, or file, a piece of slate or slit stone into the shape or form of a button; leaving a cross or space in the top, to receive the knot or tied ends of the catgut, silk, wire, or other material; which latter is to be put through one or more holes, perforated or drilled through the slate or slit stone, for that purpose; the ends of the loop are afterwards tied in a knot, to keep them fast or secure to the slate or slit stone. This being effected

fected, another piece of ſlate or ſlit ſtone is then to be glued or cemented to the top of the former piece, with a receſs without; after which, the button is finiſhed by turning it in a lathe, or by grinding, cutting, filing, or otherwiſe making it ſmooth and even. If a ſhank of metal is wanted, or preferred, inſtead of the loop of catgut, ſilk, wire, or other material, the ſhank is to be put into or through a ſingle piece or pieces of ſlate or ſlit ſtone, glued or cemented together, by matting, or otherwiſe putting through the ſlate or ſlates, and leaving a metal ſtud, or other ornament, on the top of the button: Or the ſhank may be inſerted or put through wood, leather, paper, or other material; and then the ends of the ſhank, being returned or beat down upon the ſurface, may be filed, ground, and made ſmooth, ſo as to be glued, cemented, or fixed, to the piece of ſlate or ſlit ſtone, as before. After the buttons are ſo made and finiſhed, they may be engraved, engine-cut, painted, japanned, or otherwiſe ornamented, as fancy may ſuggeſt. In witneſs whereof, &c.

XLI. *On the Art of making Kelp, and of encreasing the Growth of the Marine Plants from which it is made. By Mr.* ANGUS BEATON, *Canongate, Edinburgh.*

From the PRIZE ESSAYS of the HIGHLAND SOCIETY of SCOTLAND.

KELP is made from plants which grow on the sea-shores, between high and low water mark. All shores are not equally adapted for the production of these plants: on such as are exposed to the ocean, the rolling of the waves and the fury of the tempests prevent the plants from taking root. They thrive best in sheltered bays, where the retreat of the tide leaves an extensive surface uncovered, and where the bottom is composed of stones or rocks, to fasten their roots. Only the plant called *Tangle*, and some others which adhere with great force to the rocks, are found to grow on exposed situations. But these are always within the low water mark of ordinary tides, and can only be procured at the very low ebb of

ſpring tides: they are, however, ſo ſtrong and ſubſtantial, that they will amply reward the labourer for his trouble.

The moſt proper time for commencing the making of kelp, is about the middle of ſpring, provided the weather be good. It is much ſafer to begin early, than late. When the operations are protracted until the harveſt is far advanced, the winter rains will be faſt approaching, and the burning will be rendered much more difficult.

Though the ſpring be the beſt ſeaſon for making kelp, yet, owing to other avocations at that ſeaſon, it is ſeldom made except during ſummer.

To prepare the materials for making kelp, the firſt thing to be done is, to cut the ſea weeds with hooks or ſickles. Meanwhile, the aſpect of the ſhore, and the time and rapidity of the tides, ſhould be examined. If the ſhore be level, the ware may be conveyed by horſes and carts, as faſt as it is cut, to the place where it is to be dried and burnt.

But, if the ſhore be rugged, or, from any cauſe, does not admit a horſe to travel through it, then, at low water, lay a ſtrong rope around all the ſtuff that is cut, before the return of the tide. To increaſe the diameter of the rope, it ſhould be twiſted round with the longeſt ſea plants that can be got. When the tide begins again to flow, all the plants that were cut will ſoon be ſet afloat,

and

and will be collected in the rope, as in a net. As the tide advances, they may be gradually dragged towards the ſhore, and to the moſt convenient part of it. At high water, the ware ſhould be dragged as far up as poſſible; and the rope ſhould ſtill be allowed to remain around it, until the whole is carried away, or otherwiſe ſecured.

But, if the contiguous land be inacceſſible, or unfit for drying the ware, every poſſible advantage muſt be taken of the tide and ſituation, to move it to a more convenient place. In ſuch a caſe, one end of the rope muſt be put through a ring in the other end, and tightened, ſo as to contract the ware into a ſmall bulk. When this is done, there will be little difficulty in moving it along with the current, unleſs a ſtrong wind ſhould blow in the oppoſite direction. When this happens, the rope muſt be tightened as much as poſſible; and then it will expoſe very little ſurface to the wind, as moſt of the ware will be under water.

When it is neceſſary to ſteer againſt the ſtream, the maſs of ware ſhould be kept in as ſnug a ſituation as poſſible, until the ſtream becomes leſs violent, which always happens ſometime before high water; then the rope ſhould be drawn with caution; for, if it is pulled too faſt, it will

be

be in danger of ſlipping either above or below the ware.

If the mouth of a river muſt be croſſed, and the maſs of ware be heavy to row, and difficult to ſecure, a man placed in the ſtern of the boat, with the end of the rope in his hand, in order to produce a conſtant draught, will forward the work more than the addition of another oar. This may appear ſtrange to thoſe who are unacquainted with ſuch work; but I can aſſure the reader, that this, and the other remarks in this treatiſe, are matters of fact, confirmed by the experience of many years.

After the ware has reached the deſired place, it muſt be dried in the ſame way that hay is made; taking care to let it get as little rain as poſſible. When dry, it ſhould be coiled or ſtacked up for burning, and the ſtacks ſo formed as not to admit rain.

Burning or Melting the Kelp.

As this proceſs is the finiſhing of the work, I ſhall be more particular concerning it. The firſt thing to be conſidered is, the quantity of ſtuff to be burnt, in order that the kiln may be conſtructed of the proper length. The breadth of theſe kilns ought always to be 28 inches. If the kilns be two or three inches narrower, they will

not

not contain a ſufficient quantity of ſtuff to raiſe a proper heat. Making them wider is ſtill worſe; for then ſome of the ſtuff in the middle will not be half burnt. With the aſſigned breadth, they may be extended in length, as far as the quantity of ſtuff to be burnt may require.

The kilns are commonly made of various lengths, from 8 to 18 feet, and about 2½ feet high; they are built of ſtone, and placed ſideways to the quarter from which the wind commonly blows. It is proper to cover the windward ſide with green turf; and, if the wind be high, to cover it even all round with turf, as occaſion may require.

Some have been ſo abſurd as to dig a round hole in the earth, and line it with ſtone. But the ſoap-boiler and bleacher muſt ſuffer by this practice; as a kiln of this conſtruction, by excluding the air, cannot raiſe a ſufficient heat. Of courſe, there muſt be a conſiderable proportion of the ſtuff, in ſuch a kiln, that remains not completely burnt; and what is left in that ſtate yields no ley. A ſtrong wind, regulated by the turf-ſods on the ſides of the kiln, is moſt favourable for the complete burning of the materials.

The kiln being made as directed, it is next neceſſary to provide fuel. It is indifferent what ſort it be, provided it be properly ſet. If it be wood, or heath, it ſhould be ſet on end, ſo as to fill the

the whole kiln from one end to the other. If heath is uſed, the top ought always to be put undermoſt; and the ſtrongeſt ſort that can be got ſhould be preferred.

The kiln being thus filled with fuel, ſome of the drieſt ware ſhould be ſpread lightly over it, until the whole be covered. Then, if the day appears good, the fire ſhould be applied at the end which is fartheſt from the wind. It muſt now be lightly and conſtantly ſupplied, as it needs, with freſh ware, thrown, by the hand or a pitch-fork, upon every red hole that appears. In calm weather, when it burns ſlowly, it ſhould be lightly fed, that it may get air. If the weather be very calm, the turf cover ſhould be removed from both ſides of the kiln. If there be a ſlight wind, the windward ſide, at leaſt, ſhould be covered. If the wind ſhould riſe, both ſides ſhould be inſtantly covered; and, if it riſe high, the covering ſhould be doubled, as circumſtances may require.

During the whole proceſs, every hole that appears ſhould be quickly and attentively filled with freſh materials, until the whole is burnt that is meant to be done at that time. Then the feeding ſhould ſtop all at once; and every hole that appears ſhould continue to be filled with a fork, from the thickeſt leaſt-burnt portions, until the

ſtuff

ſtuff is ſeen to ſoften, or melt, at the ſtones. This is the moſt critical period of the whole proceſs: for ſometimes, in cold weather, it is apt to freeze or harden on a ſudden: to prevent this, it muſt be inſtantly wrought as directed afterwards. The inſtruments uſed for this purpoſe are ſtrong narrow clads or clatts, with long handles of iron. Before theſe are applied to the materials, they muſt be previouſly heated over the flame; for, a cold body introduced among the ſtuff, at this ſtage of the proceſs, would cauſe what is already prepared or melted, to fly in the face of the workman, or to ſcatter about.

The operation begins at the corner fartheſt from the wind, by preſſing down a little of the unmelted ſtuff to the bottom of one of the holes neareſt to the ſtones. If it is ſeen to boil, ſoften, or melt, more ſtuff muſt be added, and preſſed down as before. When that has become proper ſtuff, continue to add more; as the ſuperior heat of that part, will aſſiſt the parts that are unwrought. It muſt then be wrought backwards and forwards, until the maſs is brought to a proper conſiſtency. When that is done, this portion ſhould be dropped, and another portion, contiguous to it, ſhould be taken and wrought in the ſame manner, until the whole is finiſhed. Sometimes a portion of the kelp will be found frozen on the ſides of the kiln: this may be taken off,

while working, and mixed with the reſt, in ſuch proportion as not to cool the part that is preparing.

But if, when you begin to try this operation, the materials ſtill continue hard and dry, they may be allowed to burn a little longer. When again tried, if they ſtill remain dry, like aſhes, a little common ſalt, ſprinkled over the whole of the ſtuff, will add greatly to the force of the fire. If it ſtill continues obſtinate, add more ſalt; and, if the weather be calm and warm, let the kiln have little or no covering on its ſides, unleſs its contents be threatening to freeze.

If the ſalt have not the deſired effect, which ſeldom happens, mix a little ſaltpetre with it, which will cauſe it to burn vigorouſly: or, if it be very dull, a little of the flowers of brimſtone will produce the ſame effect.

This diſagreeable double toil ſeldom occurs, except in bad weather, or when the ware had got rain at the drying. Ware that is dirty or ſoiled, from having grown in confined muddy bays, is alſo liable to this accident. The workman ſhould endeavour to rinſe ſuch ware with his grape or fork, while it is floating in the rope; which will waſh away moſt of the mud, and render it more fit for working. As this kind of ware is commonly more rank and ſtrong than any other, it ſhould be well dried, ſtacked, and kept ſome time, until

til it is grown grey within; after which, it will work much better.

When a new burning commences, if much duſt and aſhes remain from a former burning, the ſmaller parts may be fed into the kiln, with the freſh ware or wrack, after it has begun to burn vigorouſly; and, towards the cloſe of the proceſs, the largeſt and hardeſt parts may be placed in a row, along the centre of the kiln, from end to end; and thus the heat will bring the whole into fuſion, ſo as to form kelp.

After the kelp is made, it ſhould be carefully excluded from air and moiſture, and it will keep for ages.

It is eſteemed of good quality when, on breaking a piece, it is found to be hard, ſolid, and reſembling good indigo; that is, when it has ſome reddiſh and light blue ſhades running through it.

When it has none of its peculiar ſalt taſte, it is unfit for making ley, though it may be of uſe to glaſs makers.

By diſſolving a little of it in water, you can aſcertain if it has been adulterated by ſand, mortar, or ſtones; though it is impoſſible to make kelp free of ſome ſand and ſtones, in the ordinary ways of preparing it.

How to prepare the Shore, ſo as to increaſe the Materials of which Kelp is made.

To ſome, this may appear too laborious a taſk; but, to ſuch perſons I have only to recommend that they ſhould look on, while others, more induſtrious than they, within the ſpace of three or four years, are reaping the fruits of their toil.

To enlarge the ſubmarine field, that part ſhould be ſelected which is moſt convenient for improvement. It ſhould be either a bay, or channel, or ſome part that is not expoſed to the fury of the open ſeas, where the perpetual agitation of the water would prevent the ware from taking root. The place ſhould alſo be as free as poſſible from mud and quickſand; and, the more flat it is, the fitter for improvement.

The extent to which the ſhore may be made to produce ſea-weeds, is, from the flood-mark to the loweſt ebb of neap-tides. Having aſcertained this, convey the neareſt ſtones that can be got, of a conſiderable ſize, to the place to be improved. Beginning at the loweſt part, the ſtones ſhould be placed in rows, directed towards the neareſt convenient paſſage from the ſea to the place of drying. It may alſo be obſerved, that the more the ſtones are expoſed to the air, the more they are fitted for carrying a heavy crop of ſea-weed. Hence,

Hence, it would be proper to make the end of every ſtone that is laid, in ſucceſſion, reſt upon the one that was placed before it. By this mode of arranging them, they will be leſs apt to ſink in the mud, and they will expoſe a greater ſurface for the growth of ware. The rows ſhould alſo be at a proper diſtance from each other, both to allow room for the plants to grow, and to afford a paſſage for conveying them away. A beach, treated in this manner, will, in four years, yield as good a crop as the natural ſhore; which, in many ſituations, would prove of infinite advantage. Where the ſtones are at hand, the work can be executed at leſs expence than one would imagine; and, even where they are diſtant, it ſhould be conſidered that the expence is but temporary, the advantage perpetual.

It may alſo be obſerved, that there are various ſorts of *Ware, Fucus*, or *Sea-wrack*; each of which grows in a particular depth or ſituation, in the ſea. By obſerving the degrees in which each plant grows, every perſon has it in his power to increaſe the quantity of that ſort of ſea-weed which beſt ſuits his purpoſe; for he has only to mark the ſituation where that ſort is naturally inclined to grow, and place his ſtones accordingly.

XLII. *Account of a new Method of propagating Potatoes. By the Rev.* J. Barton.

From the Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture, &c.

In May laſt, a plantation of raſpberries, which had been made in potatoe-ground the preceding autumn, was choaked up with potatoe-ſtalks, from the negligence of the labourers in clearing and preparing the ground. A thought ſtruck me, that they might be made beneficial plants, inſtead of being thrown away as weeds, which had hitherto been the caſe, whenever they grew in forbidden ground. I therefore dug them up carefully, and planted about a hundred of them, as I would cabbages, in drills, (ſome manure having been previouſly laid,) and pulled off the potatoes that adhered to the roots of the ſtalks. On digging them up laſt autumn, I found that the experiment had ſucceeded beyond my expectation: every ſtalk produced from ten to fifteen potatoes, none very ſmall, and ſome of an uncom-

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mon large ſize. I weighed the produce of a dozen ſtalks, and found that they amounted to twenty-ſeven pounds; but theſe I took as they lay contiguous to each other in the drill; had I weighed the produce of picked ſtalks, I am ſatisfied the weight would have been near forty pounds.

The benefits that will ariſe from this experiment, if the mode be generally practiſed, I take to be the following: whenever potatoes ſhall be left in the ground, the ſtalks that grow from them will reward the induſtry of the farmer, in clearing the ground of them; and the potatoes (adhering to the roots) may be given to the pigs.

The man of fortune will give theſe ſtalks to his cottagers, or to poor people, to plant in their little gardens; which muſt be a relief to them, when potatoes happen to be ſcarce in the ſpring.

Thoſe who have ſmall potatoes, only fit to be thrown to their hogs, can make beds of them in November, and plant out the ſtalks in ſpring, or ſell them in the market, as they would cabbage-plants. In many places, the inhabitants are obliged, from the wetneſs and poverty of the ſoil, to defer planting their potatoes till late in the ſummer, too late to have any conſiderable produce. I imagine that this mode of culture would ſucceed much better in ſuch caſes than the common method; for there would be no danger of the

the ſtalks rotting in moiſt ground, as the ſeed-potatoes are apt to do; beſides which, leſs manure would be neceſſary. I think alſo, that there would be a conſiderable ſaving in labour by this method of cultivation; for, a field deſigned for potatoes, could be prepared like a field for cabbages, and planted out in the ſame manner.

It has one advantage over Mr. Maunſell's plan, or ſetting from the ſhoot; becauſe I am informed, that crops, in his mode of culture, are liable to fail in particular ſeaſons. This, I ſuppoſe, will never be the caſe in my method; becauſe nothing, I imagine, can materially injure the ſtalks, except froſt. Now, this inconvenience can be eaſily avoided; becauſe they need not be planted till all biting froſts are over. Any time from the middle of March to the middle of June will anſwer for the purpoſe; for a perſon told me, who took the hint from me, that in weeding his potatoes laſt ſummer, he pulled out the lateral ſtalks from the main ones, in order to ſtrengthen the latter, and planted them out, in my method, juſt as they were opening into bloſſom; and that he had an excellent crop from them.

If any ſtalks happen to be too long at the time of planting, they may be cut ſhort, like a cabbage-plant, and they will grow equally well.

XLIII.

XLIII. *An Inquiry concerning the Weight ascribed to Heat.* *By* BENJAMIN *Count of* RUMFORD, *F. R. S. M. R. I. A. &c.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

THE various experiments which have hitherto been made with a view to determine the question so long agitated, relative to the weight which has been supposed to be gained, or to be lost, by bodies upon their being heated, are of a nature so very delicate, and are liable to so many errors, not only on account of the imperfections of the instruments made use of, but also of those, much more difficult to appreciate, arising from the vertical currents in the atmosphere, caused by the hot or the cold body which is placed in the balance, that it is not at all surprising that opinions have been so much divided, relative to a fact so very difficult to ascertain.

It is a considerable time since I first began to meditate on this subject, and I have made many experiments with a view to its investigation:

 in

in these experiments, I have taken all those precautions to avoid errors, which a knowledge of the various sources of them, and an earnest desire to determine a fact which I conceived to be of importance to be known, could inspire; but, though all my researches tended to convince me more and more, that *a body acquires no additional weight upon being heated*, or rather, that heat has no effect whatever upon the weights of bodies, I have been so sensible of the delicacy of the inquiry, that I was for a long time afraid to form a decided opinion upon the subject.

Being much struck with experiments recorded in the Transactions of the Royal Society, Vol. LXXV. made by Dr. Fordyce, upon the weight said to be acquired by water upon being frozen; and being possessed of an excellent balance, belonging to his most serene highness the Elector Palatine Duke of Bavaria; early in the beginning of the winter of the year 1787, as soon as the cold was sufficiently intense for my purpose, I set about to repeat those experiments, in order to convince myself whether the very extraordinary fact related might be depended on; and, with a view to removing, as far as was in my power, every source of error and deception, I proceeded in the following manner.

Having provided a number of glass bottles, of the form and size of what in England is called a

Florence flask, blown as thin as possible, and of the same shape and dimensions, I chose out from amongst them two, which, after using every method I could imagine of comparing them together, appeared to be so much alike as hardly to be distinguished.

Into one of these bottles, which I shall call A, I put 4107,86 grains Troy of pure distilled water, which filled it about half full; and into the other, B, I put an equal weight of weak spirit of wine; then, sealing both the bottles hermetically, washing them, and wiping them perfectly clean and dry on the outside, I suspended them to the arms of the balance, and placed the balance in a large room, which for some weeks had been regularly heated every day by a German stove, and in which the air was kept up to the temperature of 61° of Fahrenheit's thermometer, with very little variation. Having suffered the bottles, with their contents, to remain in this situation till I conceived they must have acquired the temperature of the circumambient air, I wiped them afresh, with a very clean dry cambric handkerchief, and brought them into the most exact equilibrium possible, by attaching a small piece of very fine silver wire to the arm of the balance to which the bottle which was the lightest was suspended.

Having suffered the apparatus to remain in this situation about twelve hours longer, and finding no alteration in the relative weights of the bottles, (they continuing all this time to be in the most perfect equilibrium,) I now removed them into a large uninhabited room, fronting the North, in which the air, which was very quiet, was at the temperature of 29°, F; the air without doors being at the same time at 27°; and, going out of the room, and locking the door after me, I suffered the bottles to remain forty-eight hours, undisturbed, in this cold situation, attached to the arms of the balance as before.

At the expiration of that time, I entered the room, using the utmost caution not to disturb the balance, when, to my great surprise, I found that the bottle A very sensibly preponderated.

The water which this bottle contained was completely frozen into one solid body of ice; but the spirit of wine, in the bottle B, showed no signs of freezing.

I now very cautiously restored the equilibrium, by adding small pieces of the very fine wire of which gold lace is made, to the arm of the balance to which the bottle B was suspended, when I found that the bottle A had augmented its weight by $\frac{1}{35904}$ part of its whole weight at the beginning of the experiment; the weight of the bottle with its contents having been 4811,23 grains Troy,

Troy, (the bottle weighing 703,37 grains, and the water 4107,86 grains,) and it requiring now $\frac{134}{1000}$ parts of a grain, added to the opposite arm of the balance, to counterbalance it.

Having had occasion, just at this time, to write to my friend Sir Charles Blagden, upon another subject, I added a postscript to my letter, giving him a short account of this experiment, and telling him how "*very contrary to my expectation*" the result of it had turned out; but I soon after found that I had been too hasty in my communication. Sir Charles, in his answer to my letter, expressed doubts respecting the fact; but, before his letter had reached me, I had learned from my own experience, how very dangerous it is, in philosophical investigations, to draw conclusions from single experiments.

Having removed the balance, with the two bottles attached to it, from the cold into the warm room, (which still remained at the temperature of 61°,) the ice in the bottle A gradually thawed; and, being at length totally reduced to water, and this water having acquired the temperature of the surrounding air, the two bottles, after being wiped perfectly clean and dry, were found to weigh as at the beginning of the experiment, before the water was frozen.

This experiment being repeated, gave nearly the same result, the water appearing, when frozen,

zen, to be heavier than in its fluid ſtate; but, ſome irregularity in the manner in which the water loſt the additional weight which it had appeared to acquire upon being frozen, when it was afterwards thawed, as alſo a ſenſible difference in the quantities of weight apparently acquired in the different experiments, led me to ſuſpect, that the experiment could not be depended on for deciding the fact in queſtion; I therefore ſet about to repeat it, with ſome variations and improvements. But, before I give an account of my further inveſtigations relative to this ſubject, it may not be amiſs to mention the method I purſued, for diſcovering whether the appearances mentioned in the foregoing experiments might not ariſe from the imperfections of my balance; and it may likewiſe be proper to give an account, in this place, of an intermediate experiment which I made, with a view to diſcover, by a ſhorter route, and in a manner leſs exceptionable than that above mentioned, whether bodies actually loſe, or acquire, any weight, upon acquiring an additional quantity of latent heat.

My ſuſpicions reſpecting the accuracy of the balance aroſe from a knowledge, which I acquired from the maker of it, of the manner in which it was conſtructed.

The three principal points of the balance having been determined, as nearly as poſſible, by mea-

measurement, the axes of motion were firmly fixed in their places, in a right line; and the beam being afterwards finished, and its two arms brought to be in equilibrio, the balance was proved, by suspending weights, which before were known to be exactly equal, to the ends of its arms.

If with these weights the balance remained in equilibrio, it was considered as a proof that the beam was just; but, if one arm was found to preponderate, the other was gradually lengthened, by beating it upon an anvil, until the difference of the lengths of the arms was reduced to nothing, or until equal weights, suspended to the two arms, remained in equilibrio; care being taken, before each trial, to bring the two ends of the beam to be in equilibrio, by reducing, with the file, the arm which had been lengthened.

Though, in this method of constructing balances, the most perfect equality in the lengths of the arms may be obtained, and consequently the greatest possible accuracy, when used at a time when the temperature of the air is the same as when the balance was made, yet, as it may happen, that in order to bring the arms of the balance to be of the same length, one of them may be much more hammered than the other, I suspected it might be possible that the texture of the metal forming the two arms might be rendered

so

ſo far different, by this operation, as to occaſion a difference in their expanſions with heat; and that this difference might occaſion a ſenſible error in the balance, when, being charged with a great weight, it ſhould be expoſed to a conſiderable change of temperature.

To determine whether the apparent augmentation of weight, in the experiments above related, aroſe in any degree from this cauſe, I had only to repeat the experiment, cauſing the two bottles A and B to change places upon the arms of the balance; but, as I had already found a ſenſible difference in the reſults of different repetitions of the ſame experiment, made as nearly as poſſible under the ſame circumſtances, and as it was above all things of importance to aſcertain the accuracy of my balance, I preferred making a particular experiment for that purpoſe.

My firſt idea was, to ſuſpend to the arms of the balance, by very fine wires, two equal globes of glaſs, filled with mercury, and, ſuffering them to remain in my room till they ſhould have acquired the known temperature of the air in it, to have removed them afterward into the cold, and to have ſeen if they ſtill remained in equilibrio, under ſuch difference of temperature; but, conſidering the obſtinacy with which moiſture adheres to the ſurface of glaſs, and being afraid that, ſomehow or other, notwithſtanding all my precautions,

precautions, one of the globes might acquire or retain more of it than the other, and that by that means its apparent weight might be increafed; and having found by a former experiment, of which I have already had the honour of communicating an account to the Royal Society, that the gilt furfaces of metals do not attract moifture; inftead of the glafs globes filled with mercury, I made ufe of two equal folid globes of brafs, well gilt and burnifhed, which I fufpended to the arms of the balance by fine gold wires.

Thefe globes, which weighed 4975 grains each, being wiped perfectly clean, and having acquired the temperature (61°) of my room, in which they were expofed more than twenty-four hours, were brought into the moft fcrupulous equilibrium, and were then removed, attached to the arms of the balance, into a room in which the air was at the temperature of 26°, where they were left all night.

The refult of this trial furnifhed the moft fatisfactory proof of the accuracy of the balance; for, upon entering the room, I found the equilibrium as perfect as at the beginning of the experiment.

Having thus removed my doubts refpecting the accuracy of my balance, I now refumed my inveftigations relative to the augmentation of weight which

which fluids have been ſaid to acquire upon being congealed.

In the experiments which I had made, I had, as I then imagined, guarded as much as poſſible againſt every ſource of error and deception. The bottles being of the ſame ſize, neither any occaſional alteration in the preſſure of the atmoſphere during the experiment, nor the neceſſary and unavoidable difference in the denſities of the air, in the hot and in the cold rooms in which they were weighed, could affect their apparent weights; and their ſhapes and their quantities of ſurface being the ſame, and as they remained for ſuch a conſiderable length of time in the heat and cold to which they were expoſed, I flattered myſelf that the quantities of moiſture remaining attached to their ſurfaces, could not be ſo different as ſenſibly to affect the reſults of the experiments. But, in regard to this laſt circumſtance, I afterwards found reaſon to conclude that my opinion was erroneous.

TO BE CONCLUDED IN OUR NEXT.

XLIV. *On the Effential Salt of Galls. By* C. W. Scheele.

From Crell's Chemical Journal.

SOME time fince, I difcovered accidentally, that an infufion of galls, made with cold water, had depofited a fediment, which was of a grey colour, and which, when held between the light and the eye, had a cryftalline appearance; it had an acid tafte, not an aftringent one; it diffolved readily in hot water; and it occafioned a precipitate of a black colour from vitriol of iron.

In order to examine more minutely the nature of this falt, I caufed a pound of galls to be reduced to a coarfe powder, which I put into a glafs veffel, and then poured on it about three pounds of pure water. When four days and four nights had elapfed, during which time the mixture was frequently ftirred with a glafs tube, I ftrained off the tincture: it was clear, and had the colour of white wine *. I then poured back

* If the infufion is made with hot water, or is digefted in a warm fituation, it is always turbid; for this reafon, I always make ufe of cold water, and fet the mixture in a cold place.

the clear infusion into the vessel in which it was made, over the mouth of which I tied some brown paper, and then set it in the open air: this was done in the month of June. When a month had elapsed, I examined the infusion, and found that it was covered with a thick mould, but had not deposited any sediment. Its taste was not so astringent as at first, but was more acid. I replaced it in its former situation, having covered it, as before, with brown paper. Upon a second examination, five weeks after the first, I observed a sediment at the bottom of the vessel, about two fingers in thickness, having a tough mould at the top; I also remarked that it had lost its astringent taste, but still produced a black colour with vitriol of iron. I then filtered the infusion, and exposed it again to the open air. Towards autumn, I found that a great part of it was evaporated, but that there was in the remainder a considerable sediment. I now put together the whole of the sediment which the infusion had deposited, and poured some cold water upon it: when it had again settled to the bottom, I decanted the liquor, and poured upon the sediment as much boiling water as was sufficient to dissolve it. I then filtered the solution, which was of a yellowish brown colour, and evaporated it by a gentle heat. By these means, a salt was formed, part of which had the form of fine sand; the other part appeared

peared like radiated cryſtals: it was of a grey colour. I repeated the ſolution and cryſtallization ſeveral times, but could not bring the ſalt to a whiter colour.

This ſalt has the following properties.

1. It has an acid taſte, effervesces with chalk, and turns tincture of litmus red. 2. Half an ounce of it requires nearly three ounces and a half of boiling water for its complete ſolution; and, as the ſolution grows cold, it becomes thick, by the formation of ſmall cryſtals. For the ſolution of the above quantity of ſalt in cold water, no leſs than twelve ounces of water are required. 3. It diſſolves readily in ſpirit of wine; and, if the ſpirit be boiling hot, an equal quantity, in weight, is ſufficient for its ſolution; but, if cold ſpirit be uſed, two ounces thereof will be requiſite for the ſolution of half an ounce of the ſalt. 4. When expoſed in a crucible to an open fire, it ſoon melts, diffuſing an agreeable ſmell, and leaving a hard coal, which cannot eaſily be reduced to aſhes. 5. If it is expoſed to the fire in a retort, it firſt melts; then yields an acid phlegm, without any oil; laſtly, there ariſes a white ſublimate, which continues in a fluid ſtate while the neck of the retort is hot, but afterwards ſhoots into cryſtals. A conſiderable quantity of coal is found at the bottom of the retort. The ſublimate is in taſte and ſmell very ſimilar

to

to the ſalt of benjamin; it is ſoluble both in water and in ſpirit of wine; it turns the tincture of litmus red; and (which is remarkable) precipitates metals from their ſolutions, of different colours; with vitriol of iron, it produces a black colour. 6. A ſolution of this ſalt in water gives a dark green colour to a ſolution of gold, making it depoſit a brown powder, which is the gold itſelf revived. 7. A ſolution of ſilver is rendered brown, and by the aſſiſtance of heat depoſits a grey powder, which is ſilver in its original ſtate. 8. Mercury is precipitated from its ſolution, of an orange colour. 9. In a ſolution of copper a brown ſediment is produced. 10. A ſolution of vitriol of iron is turned black; and, the greater the proportion of water in which it is diſſolved, the more black the mixture becomes. 11. Acetated lead is precipitated of a white colour. 12. With biſmuth, a lemon-coloured precipitate is produced. 13. The acid of molybdena is turned of a dark yellow colour, without any precipitation. 14. Platina, zinc, acid of arſenic, tin, cobalt, and regulus of manganeſe, undergo no change. 15. Solutions of calcareous earth, of magneſia, of argill, and of barytes, are not decompoſed: from lime-water a very copious grey precipitate is obtained. 16. By treating this ſalt with nitrous acid, in the uſual manner, it is converted into ſaccharine acid.

The

The white precipitate obtained, by the ſalt here treated of, from acetated lead, may be again decompoſed by vitriolic acid, and the ſalt may be then recovered in its original ſtate. As acetated lead is likewiſe precipitated by the infuſion of galls, I thought it poſſible that I might be able to procure the ſalt by a ſhorter method; in this however I was diſappointed; for, when I decompoſed the precipitate ſo produced with vitriolic acid, I obtained only the infuſion of galls again, with its original aſtringent taſte.

If galls are diſtilled with a ſtrong heat, there comes over, firſt, an acid phlegm, the ſmell of which is not unpleaſant, without any oily matter: afterwards, a volatile ſalt, ſimilar to that which is obtained from the ſalt of galls itſelf, and poſſeſſing exactly the ſame properties. It may therefore be inferred, that this ſalt muſt exiſt in the infuſion of galls, although it cannot be obtained from it by the ordinary mode of cryſtallization, owing perhaps to its being ſo cloſely united to ſome glutinous or other matter, as not to be ſeparable, except by means of an internal motion or fermentation.

XLV. *Conclusion of M.* GUYTON's *Experiments and Observations on the Properties of Platina.*

(From Page 214.)

IV. *Of the Amalgamation of Platina.*

THE queſtion, whether platina formed a true amalgam with mercury, has often been diſcuſſed. On the one hand, it was known that the proceſs of amalgamation was made uſe of in America, to ſeparate gold from platina; a circumſtance which ſeemed to prove, if not the inſolubility of the latter metal in mercury, at leaſt a very weak degree of affinity between the two ſubſtances; and, it is equally known to chemiſts, that trituration without heat, even though continued for a long ſpace of time, does not produce any amalgamation of the two metals.

On the other hand, the ore of platina brought from Spain, frequently contains mercury, which appears to have loſt a part of its fluidity by its union with ſome other metal; this cannot be attributed to iron. In the ſecond place, it is ſtated by

by Schæffer, that the amalgamation of platina might be effected, provided it were first melted with gold, or with lead. According to Count Sickengen, if the ore of platina is first digested in nitric acid, and afterwards mercury and a solution of sal ammoniac are added, a black powder (which is attractable by the magnet) is formed upon the surface; and, when that is separated, an incipient, or, as Count Sickengen calls it, an imperfect amalgamation, is found in the digesting mixture. He assures us, however, that a perfect amalgamation may be obtained, by treating pure platina with boiling mercury.

Lastly, the experiment of which I have given an account in the preceding section *, renders the success of the operation very probable; for, it certainly would be a very extraordinary circumstance, that platina should adhere more strongly to mercury, than zinc, copper, or antimony, (every one of which forms an amalgam with it,) and that it should, nevertheless, be impossible to make it enter into combination with it.

These circumstances were sufficient to induce me to try the possibility of this amalgamation; and I was very soon convinced, that nothing was necessary but that it should be assisted by heat.

* See our last Number, p. 211.

I took a lamina of platina, 26 millimetres long, and 15 wide, weighing 63,34 centigrammes *. Having bent it to the form of half a cylinder, I introduced it into a glaſs matraſs, the neck of which was 30 centimetres in length, and poured upon it 68 grammes of mercury. It muſt be remarked, that the platina conſtantly roſe and ſwam upon the mercury, even after being ſeveral times forced under it, ſo that I was obliged to keep it down by means of a glaſs rod.

This matraſs was put into a crucible filled with ſand, ſo as entirely to cover the bulb of the matraſs, and the crucible was placed in a melting furnace. The fire was kept up during the ſpace of an hour and an half; and increaſed to ſuch a degree as to make the bulb of the matraſs red hot. During the operation, the mercury roſe up into the neck of the matraſs, and fell back again, in the form of globules; part of it paſſed through its mouth, without being condenſed.

* One centigramme is equal to 0,154 grains.

In our laſt, we ſtated the gramme to be equal to 16,935 grains. The decigramme equal to 1,693 grains. The kilogramme equal to 2 lbs. 11 ozs. 5 dwts. 15 grains.

Inſtead of which, the gramme ſhould have been 15,444 grains.

The decigramme 1,544 grains.

The kilogramme 2 lbs. 8 ozs. 3 dwts. 12 grains.

This

This appeared to be the caſe, by the loſs of one-fifth part of the quantity of mercury made uſe of.

On one ſide of the bulb of the matraſs, I had placed one of Wedgwood's thermometer-pieces, that I might be able to determine the degree of heat of ſuch a ſand-bath, when heated to redneſs. I found it to be leſs conſiderable than might be ſuppoſed; the contraction of the thermometer-piece having amounted only to ſeven degrees of the ſcale.

When the matraſs was cool, I took out the glaſs rod; and obſerved that the lamina of platina did not, as before, riſe to the ſurface. Having poured off the mercury, the platina preſented the appearance of a piece of metal which had been recently tinned. The mercury adhered to it ſo ſtrongly, that only a part of it could be ſeparated by ſhaking; after which, the lamina of platina was found to weigh 135,34 centigrammes, that is, more than double its original weight. The mercury which remained attached to it, inſtead of taking the form of a globule or drop, ran or ſpread itſelf from one end of the lamina to the other, forming a protuberance only at the edge thereof. The lamina, at the projecting part, then preſented the appearance of an infinite number of ſmall angular points, which had a ſenſible analogy with thoſe cryſtals which are obſerved when mercury is poured off from ſilver, zinc, or other me-

 tals

tals ſuſceptible of amalgamation therewith, and which have been treated by diſtillation with it. Theſe points were made to diſappear by the ſmalleſt degree of friction.

In other reſpects, the dimenſions of the lamina were but little altered, except that it had evidently increaſed in thickneſs.

I tried to bend one of its corners; it broke inſtantly, like the moſt brittle metal.

A piece of it, weighing 27,87 centigrammes, was expoſed to the heat of a cupelling furnace, upon a teſt; it became black, loſt 17,25 centigrammes, that is to ſay, more than the half of its weight, and its thickneſs was diminiſhed in the ſame proportion; it, however, recovered the whole of its ductility, and only remained covered with a black powder, which was an oxide of platina, capable of being acted on by nitric acid.

I repeated this experiment, on 382,48 centigrammes of clippings of laminated platina; but, wiſhing to raiſe the heat to a higher degree, the bulb of the matraſs cracked, (probably from the mercury having condenſed on the ſides of the neck of the matraſs, and having fallen in larger maſſes than uſual,) and the ſand introduced itſelf into the inſide. That, however, did not prevent my obtaining nearly the ſame reſults; for I found that many of the clippings of platina were united, and, as it were, ſoldered together by amalgamation.

Mercury,

Mercury, therefore, diſſolves platina, and forms with it, by the aſſiſtance of heat, a true amalgam; it may be obtained in cryſtals, like thoſe of other metals, and by the ſame proceſſes; in ſhort, platina is, as well as gold, and under the ſame circumſtances, diſpoſed to oxidation by its union with mercury.

V. *Of the Action of the oxygenated Muriate of Potaſh on Platina.*

The oxygenated muriate of potaſh produces, in many reſpects, the ſame effects as nitrate of potaſh; theſe are owing principally to the oxygen ſeparated from thoſe ſubſtances. I had obſerved, a long time ſince, that platina was acted on by the latter, when it was brought to a temperature capable of keeping it in fuſion; and therefore thought it probable that the oxygen, being ſtill leſs engaged in the muriate, would alſo act upon the platina, in the ſame circumſtances. But this was merely an analogy; and chemiſtry, which had long been miſled by reaſonings founded merely on metaphyſical ſpeculations, now thinks it right to admit only ſuch facts as are proved by direct experiment. The above mentioned one appeared to me intereſting, not only as ſerving to determine the properties of platina, but alſo as ſhewing in what caſes crucibles and other

other veſſels of platina might be made uſe of, ſo as to turn their property of inſolubility to the beſt advantage, without our being under the apprehenſion of ſeeing theſe inſtruments altered by the action of the ſubſtances treated in them, or the products of the operations changed by the preſence of ſome foreign matter.

The following is the manner in which I made the trial. I heated to a white heat, in a little crucible, under the muffle of the cupelling furnace, two ſmall laminæ of platina, one very thin, weighing exactly 151 milligrammes *.

The other, which was thicker, weighed juſt 1890 milligrammes.

I threw upon them, little by little, eight grammes of oxygenated muriate of potaſh.

No detonation enſued; there were merely two or three ſparks, which appeared to be occaſioned by ſome particles of carbonaceous matter, which happened accidentally to be preſent.

The ſalt was completely volatilized, without leaving any reſiduum.

The two laminæ of platina had not undergone any apparent alteration, excepting that their ſurface had a leſs brilliant poliſh.

When weighed again in the ſame balance, they were found to have acquired as follows:

* One milligramme is equal to 0,0154 grains.

That

That of 151 milligrammes, had acquired a full milligramme, or rather more than 0,00662 of its weight.

That of 1890 milligrammes, had acquired very nearly five milligrammes, or 0,0026 of its weight.

This increaſe of weight was probably owing to oxidation, particularly as it appeared to be rather in proportion to the ſurfaces of the laminæ than to their maſſes; the ſurface of the heavieſt of the two pieces only exceeding that of the other by little more than one-fourth part.

In order to try whether the above opinion was well founded, I boiled theſe two laminæ in acetous acid.

I then put into the liquor ſome pruſſiate of lime, which inſtantly rendered it turbid, occaſioning a precipitate of a greeniſh white colour.

The liquor, being filtered, paſſed through in a turbid ſtate, and of a white colour; the greeniſh part remained on the filter.

Upon being filtered a ſecond time, it again paſſed through turbid, (but not ſo much ſo as before,) although there was an exceſs of acid.

When the laminæ were again weighed, the firſt was found to have retained three milligrammes of the five it had acquired; the ſecond, on the contrary, had loſt $\frac{1}{2}$ of a deci-milligramme * of its original weight.

* That is, leſs than $\frac{1}{1000}$ of a grain.

When

When the liquor was filtered a third time, it paſſed through clear, or nearly ſo, leaving the paper of the filter ſlightly tinged of a greeniſh colour.

The liquor was then evaporated in a ſaucer of platina, and, when reduced to one half, appeared to have again acquired a very evident tinge of light green; it afterwards left a reſiduum of the ſame colour.

It is therefore clearly proved, that platina, when heated to redneſs, may be oxidated on its ſurface by means of the oxygenated muriate of potaſh; although the ſalt is very ſoon carried off by ſublimation, and merely forms for an inſtant a fluid ſubſtance on the metal.

I have made many other obſervations upon the ſubject here treated of, particularly upon the melting and forging of platina; alſo, upon its mixture with other metals, and the properties of its oxide; but I have not yet been able to conclude ſome experiments which I have begun, and which appeared to me to be neceſſary, in order to obtain poſitive reſults, to make the proceſſes more clear, and to render our opinions upon this ſubject more fixed.

XLVI. *On the Preparation of the red Oxide of ſulphurated Mercury, commonly called factitious Cinnabar or Vermillion.* By M. Martin.

FROM THE *ANNALES DE CHIMIE.*

THE red oxide of ſulphurated mercury, or factitious cinnabar, is the reſult, as is well known, of a very intimate union of ſulphur and mercury.

The various chemiſts who have written upon this preparation, are not agreed reſpecting the proportions of ſulphur which ſhould be employed in preparing the black ſulphuret of mercury or æthiops mineral: ſome of them preſcribe three parts of mercury to one of ſulphur; others, four parts of the former to one of the latter; others, in ſhort, make uſe of a ſtill larger quantity; conſequently, we have no poſitive knowledge reſpecting the proportion of theſe materials, ſo as to enable us to produce a combination which ſhall be always the ſame. The methods of proceeding in making the preparation are equally uncertain.

In ſciences in which preciſion is required, it is neceſſary that every thing ſhould be plainly and

clearly deſcribed; the names by which things are called ought alſo to convey exact ideas of them, which is not always the caſe.

Thus, for example, the name of æthiops mineral has been given to a mixture of mercury with melted ſulphur, which is not abſolutely a true æthiops; and the name of ſulphuret of ſublimed mercury has been given to factitious cinnabar, which, according to modern diſcoveries, is conſidered as a true oxide of ſulphurated ſublimed mercury.

It has been equally erroneouſly aſſerted, that the fine deep colour of factitious cinnabar was owing merely to the juxta-poſition of the ſublimed layers, which formed maſſes more or leſs voluminous.

Experience has, however, ſhown me, that the ſame cryſtallization, and the ſame colour, may be obtained, by operating on ſmall quantities of ſulphur and mercury.

The whole art of this operation conſiſts in furniſhing the metal with the full quantity of oxygen of which it ſtands in need, in order to be combined, in a ſtate of oxide, with the ſulphur neceſſary to convert it into cinnabar.

If the trials made on a ſmall ſcale, in the laboratories of chemiſts, do not ſucceed according to their expectations, it is becauſe they are not ſuffi-

ciently

ciently acquainted with the combination of the principles neceſſary to form cinnabar.

It appears to me, therefore, that it is indiſpenſably neceſſary to determine the quantity of ſulphur requiſite for the combination of the mercury.

In fact, if only four ounces of ſulphur are employed to a pound of mercury, it will infallibly happen, that a great part of the mercury will be volatilized, before it enters into combination with the ſulphur. If, on the contrary, too great a proportion of ſulphur be made uſe of, it will be difficult to obtain cinnabar of ſo fine a colour as may be wiſhed.

On conſulting the different authors who have treated of this preparation, it will be found that they all agree in ſaying, that the Dutch are the only perſons who have hitherto ſucceeded in bringing it to the degree of perfection of which it is capable: they are excluſively in poſſeſſion of this important branch of commerce, which is extremely uſeful in medicine, and in the arts; and we have for a long time been obliged to procure it from them. This was alſo the caſe with reſpect to the oxygenated corroſive muriate of mercury, and the mild muriate of mercury, of which I firſt eſtabliſhed a manufactory in France, in 1785.

I intend, on ſome future occaſion, to make my proceſſes public; and it is, in fact, the above

two preparations which have induced me to proceed in the ſame manner upon factitious cinnabar, which is the ſubject of this memoir.

I obſerved, that the known proceſſes for obtaining the red oxide of ſulphurated mercury could not completely ſucceed on a ſmall ſcale; and that they occaſioned a conſiderable loſs of matter when employed in operating upon large quantities.

By availing myſelf of the obſervations of thoſe chemiſts who have written on this operation, I diſcovered that, by carrying the combuſtion of the melted ſulphur to a greater degree than they recommend, at the time when the mercury is mixed with it, it was poſſible to obtain, by ſubſequent ſublimation, a cinnabar of the fineſt colour, and which is at leaſt equal in beauty to that of the Dutch.

The following proceſs, which I made uſe of, will place the theory of cinnabar, and the degree of perfection to which it may be brought, in the cleareſt point of view.

I took one pound of ſulphur in ſticks, which I pulverized, and then liquefied in an unglazed earthen pot. I poured, or rather dropped, gradually into this melted ſulphur, two pounds of very pure mercury. I ſtirred this mixture about, very rapidly, with a tobacco-pipe, taking every precaution to prevent its catching fire; or, if it did take fire, I took

took care to cover the pot inſtantly, in order to ſtifle the flame; by means of this precaution, and the ſtirring, the mercury became perfectly well mixed and united with the ſulphur. When the matter was cooled, I took it out of the pot, and triturated it in a marble mortar. I then impregnated this powder with a ſufficient quantity of nitric acid, and expoſed it to a gentle heat, in an earthen veſſel placed in a ſand-bath: ſome nitrous gas, and a little ſulphur, were diſengaged from it. After the mixture was dry, I introduced it into an earthen matraſs, and proceeded to ſublime it by a naked fire, gradually increaſed to redneſs. I obtained a cinnabar of a beautiful red colour, cryſtallized in fine needles, lying one upon the other.

It is eaſy to perceive how important a part the nitric acid acts in this proceſs. Its oxygen combines with the mercury, and reduces it to the ſtate of an oxide. The ſulphur with which it is united enables it to riſe; and the intimate combination takes place within the veſſel, during the ſublimation.

If we apply the principles and the theory of modern chemiſtry to what paſſes in this proceſs, is there not ſome reaſon to believe, that the ſulphur, in burning, by abſorbing the oxygen of the air, is converted firſt into ſulphureous acid, and afterwards into ſulphuric acid? A part of the ſulphureous acid is volatilized, and loſt

in the atmoſphere; but the other part, which has retained more oxygen, and is in contact with the mercury, is decompoſed by this metal.

The mercury ſeizes on the oxygen which is inſtantaneouſly formed, and becomes oxidated; whilſt the baſis of this acid recovers its original ſtate of ſulphur.

In order that the operation here deſcribed may ſucceed completely, it is neceſſary that the mercury ſhould be oxidated, at the expence of the acidification of the ſulphur, cauſed by its combuſtion, and afterwards by the decompoſition of this ſuddenly formed acid, which abandons its oxygen to the mercury.

It may, therefore, be looked upon as demonſtrated, that cinnabar is a true oxide of ſulphurated mercury; and that its perfection depends entirely on the mercury being oxidated, previouſly to its ſublimation with the ſulphur.

XLVII. *List of Patents for Inventions, &c.*

(Continued from Page 216.)

William Turner, and John Turner, of Lane End, in the parish of Stoke upon Trent, in the county of Stafford, Potters; for a method of manufacturing porcelain and earthen ware, by the introduction of a material not heretofore used in manufacturing those articles. Dated January 9, 1800.

Isaac Sanford, of Hartford, in the State of Connecticut, in North America, Gentleman, at present residing in the parish of St. Paul, Covent-Garden, in the county of Middlesex; for a method of manufacturing and making bricks, tiles, and pottery-ware in general, and of discharging the moulds used therein. Dated January 13, 1800.

Thomas Parkinson, of Market-square, in the parish of St. George, Bloomsbury, Gentleman; for an hydrostatic engine or machine, for the purpose of drawing beer, or any other liquors, out of a cellar or vault; or for raising water out of mines, ships, and wells; or for any other purpose where fluids are required to be raised. Dated February 1, 1800.

Edward Coleman, of ———; for an artificial frog, which, being applied to the natural frogs of horses' feet, will effectually prevent contracted hoofs, thrushes, and cankers. Dated February 1, 1800.

Edward Shorter, of Newington, in the county of Surrey, Mechanic; for a machine or engine for working and causing the progressive motion of ships and vessels of every description, without the assistance of sails or oars. Dated February 4, 1800.

Samuel Miller, in the parish of St. Mary-le-bone, in the county of Middlesex, Engraver; for a machine and process for more easily dividing hard substances, as well as for raising all kinds of heavy weights, and driving all sorts of machinery. Dated February 4, 1800.

ERRATUM.

In our last Number we stated, that the term of Mr. James Turner's Patent for making a Yellow Colour, &c. called Patent Yellow, was expired; but, having since discovered that an Act of Parliament was passed in the year 1792, granting to him an extension of the said patent, for the term of eleven years from the 24th day of June in the same year, we contradict that statement, his patent being still in force.

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REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER LXXI.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

XLVIII. *Specification of the Patent granted to Mr.* JOHN HARMAR, *of Sheffield, in the County of York, Clerk; for a Machine for raiſing a Shag on all Sorts of Woollen Cloths, and cropping or ſhearing them, which together come under the Deſcription of dreſſing Woollen Cloths; and alſo for cropping or ſhearing Fuſtians.*

WITH A PLATE.

Dated March 27, 1787.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that in obedience to the ſaid letters patent, and to the aforeſaid proviſo or con- dition

dition therein contained, I the said John Harmar do by these presents particularly describe and ascertain the nature of the said invention, referring to the drawings in the margin of these presents, which I explain as follows.

A, (Plate XIII.) a shear-board, with a small curve. B, round A a frame is erected, falling a little before its level, with pillars at each corner, framed both at top and bottom, as in the drawing. C, a loose frame on which E rides. D, the blocks of wood, to give an inclination to C; this inclination is nearly in the proportion of an inch in a foot. E, the shears, as used by croppers, with their bobs or levers, which by a line work them. F, the screws on C, to hold a rail, extending from one to the other, to steady the working blade of E. G, the harness, in two parts, and is fitted to each end of the riding blade of E; being hollowed to the bow, and grooved, to admit both ends of the said riding-blade, and fastened on with screws and bands; it is farther composed of six wheels in each part, two at each end, one so fixed as to roll in the under side of C, and to keep C in its due course: the other eight are fixed in two narrow frames, having four strong screws rivetted to each frame, yet so as to turn; these, passing through their nuts fixed in the harness already named, being turned, raise or lower the edges of

E, as

E, as may be found neceſſary to the due performance of their work. H, the rod, carrying a ſmall crank at each end, with a ſmall pulley. I, the ſtraps of wood, fitted at one end to the handle of the cranks of G, and terminating by mortiſes and tenons, with two ſmall beams, where they are faſtened with pins, with liberty to work. K, two pillars, with apertures on the top, and ſituated at both ends of A. L, two ſmall beams, communicating at one end with I, and paſſing through the apertures of K, where they are fixed with pins, on which they work, but ſo as to ſhift on occaſions, to give the neceſſary vibrations to their extremities, to advantage the cranks, that they give the neceſſary preſſure on the levers of E. M, a rail, extending the length of G, with a ſmall aperture down the middle, and is fixed by ſcrews at each end to the extremities of L, which project to the right of A. N, a ſmall frame, with four ſmall friction pulleys fixed in it, and a tongue coming through the aperture of M. O, a line, communicating from the tongue of N to the lever of E: when therefore the ſmall pulley from the letter H gives motion to its cranks, this acting upon I, L, M, O, and the lever or bob of E, the blades of the ſhears cloſe, for the purpoſe of cropping, that the ſhears may produce the proper effect, the one giving a progreſſion. P, an

axis, carrying a small cog-wheel at one end, and a pulley, with five grooves in it, as answering to another, that stands inverted on S. Q, another axis, carrying two different sized cog-wheels; the larger of which is worked by the small cogs on P. R, the third and last axis in the progressive frame of wheels and pullies, carries a large cog-wheel and a pulley, with two grooves in it, and is worked with the small cog-wheel on Q, as represented in the drawing. S, an axletree, with pulleys, for bands to the first movement. T, the bands, communicating from the pulleys R to G, where they are fastened by straps and buckles. When therefore the pulley on S gives motion to P and Q, the pulley on R gives progression to E, and, by varying the bands into the different grooves of P, E is given a necessary progression in cropping or shearing of cloth or fustian.

For stopping the Work on all necessary Occasions.

U, the strap from X, communicating, by W, to one of the steps of H. W, a frame, turning on its supporter near one end, to encrease its power as a lever fastened with liberty for a small movement. X, a lever crossing the upper end of B, and by U acts upon W; so, by pressing down

down or raiſing the extremity of X, the pulley on H riſes or ſinks, and E, by means of Z, is wholly ſtopt. Y, a lever, which turns on a ſwivel near one end, and being attached by a band to that ſhears which rides on the other part of C, by its action thruſts the extremity of X from under its pin, and ſo E ſtops itſelf. Z, the bands which communicate from both ſides of the fulcrum of X, and are faſtened to the pulley on R, in contrary directions; therefore, the movement X throws out or in the cogged-wheel on R, and E ſtops, or is put in progreſſive action. *a*, the rollers, to which *b* are attached, in different directions. *b*, the bands for the management of E. *c*, the ſmall pulleys, through which *b* paſs to G, and are faſtened, by bands and buckles, in the direction of *b*, on *a*, that, by turning *a* to the right or left, E may be moved to any ſituation on C. *d*, a narrow frame, extending the length of C, carrying a lever faſtened at one end, to which a rope is attached, as in the drawing. *e*, the ropes, communicating from each corner of C to the extremities of *d*, that, by the preſſure of the lever of *d*, C may be raiſed, to give liberty to move E to all neceſſary purpoſes. *f*, a rope, which being faſtened to the extremities of X, and communicating with L, when E moves X, the weight on the other end of the rope raiſes the extremity of

X to

X to a convenient height, and keeps L from pressing down the bob, to the damage of E.

For raising a Shag.

g, a table is erected, and hath considerable inclination from side to side, the cloth passing over it, as in the drawing. *h*, two planks, fluted or guttered from end to end, and fixed at each end of *g*. *i*, a frame, nearly in breadth with *g*, and falling within *h* at both ends, grooved in the inside of both the said rails, and extending from end to end. *k*, a wheel, attached to each end of *i* by screws, with straps of iron, and which work in the gutters of *h*. *l*, a small frame, carrying a pulley at each corner, which rolls within the grooves of *i*; this has also a door to it, with handles, or small frames, set with teazles on the under side, and turns on hinges, and is fastened with a screw or cotter. The said handles are fixed in their places by springs, with hooks to them at the one end, and the other falls into notches. *m*, a strong rod, with cranks and pulleys, as H in shearing, save only a pulley more, with cranks much larger than H, and the pulley that carries them is of a considerable diameter. *n*, rails, with a working joint in them, on that side of *o* next to *m*. *o*, pillars, with a pulley fixed in,

in each, at a convenient height, that the action of the crank may be regular, and to lessen the friction of *n*. *p*, two screws, fastened at the foot to *i*, and passing through *n*, and, by the respective movement of feathered nuts on each side, are varied to the inclination of *g*. *q*, springs, with bands and buckles, which communicate with the short rails of *i*, and are tightened sufficient to raise it; when *k* has passed down the lower gutter of *h*, then the springs cease to act, and, letting *i* fall, the action is continued for raising the shag on woollen cloth. *r*, the rollers, situated before and behind *g*, with the cloth passing from one to the other. *s*, the roller above the table, to ease the passage of the cloth, and keep it better to the work. *t*, the frame of wheels for progression, as in shearing, except that the first axis in the frame has but one groove; on the second is a crank-wheel; and the third is grooved as *p* in shearing, but of a larger diameter. *u*, a pulley, with five grooves, answering to that on the last axis of *t*; these standing in contrary directions, by changing the band into its different grooves, the cloth keeps nearly regular in passing through the work. *w*, the line communicating with a frame, as *d* and *e* in shearing, and, by turning *x*, *l* is raised to and from its work. *x*, an axletree, with its lever, cogged-wheel, and stop. *v*, four cog-wheels,

in

in a frame, as in ſhearing; they act by the axletree of the firſt, being mortiſed into the ſecond axletree of *t*, progreſſive; the third or laſt axis carries a wheel, with ſmall projections on one ſide, to catch the end of a hammer, which, falling on a bell, tells nearly what cloth has paſſed through the work, that the handles in *l* may be turned or changed. *z*, the beam, worked by the crank-wheel on the letter *t*.

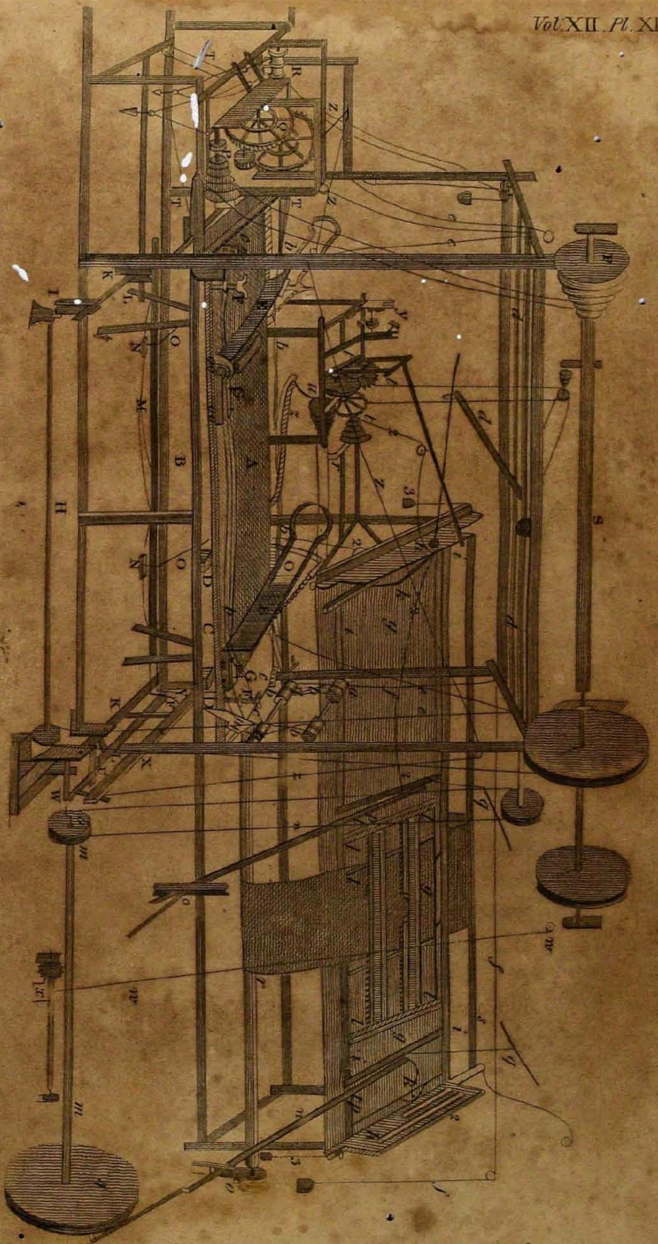
Figure 2, the bands fixed to the extremities of letter *z* and *l*, acting alternately on *l*, that the ſhag may be regularly raiſed from one liſt to the other. 3, the weights at each corner of *h*, to keep *l* to its work, and to act againſt *x*. 4, the pulley-wheel, to carry the cranks, and communicates with the firſt movement. 5, the pulley, that carries the progreſſive wheels for raiſing the ſhag, and the regulator *y*, for ſtopping the work for raiſing the ſhag, or putting it in motion; *x*, *u*, *w*, in ſhearing, acting on one of the ſteps of H, and ſo looſening or tightening the band that communicates with the firſt movement, ſtops the work for raiſing the ſhag, or puts it in motion, or by placing two pulleys in a narrow frame, through which the band paſſeth from 4 to the firſt movement; this frame being faſtened, within a little of one end, with pins, the raiſing or ſink-

ing the other, tightens or ſlackens the band, and the work of raiſing the ſhag ſtops or goes forward.

And I do declare, that the ſaid invention is to be performed, as to the cropping or ſhearing part, in manner following; that is to ſay: The cloth being put to work G, as in the drawing, and acroſs the ſurface of A, and the edges of E being brought to the exact angle of A, either by the ſcrews on G, or on the feet of *a*, that extremity of X which projects to the right hand of C being preſſed down, the pulley of H is tightened, and the pulley on the extremity of S, which communicates with the firſt movement, puts the cranks of H in motion, and alſo the progreſſive wheels; ſo that M, by O acting upon the lever or bob of E, the working goes on; when the foremoſt ſhears reach the liſt, X is thrown from under its pin by Y, and E wholly ſtops, when, by a preſſure on the lever of *d*, E is raiſed from its work, and, by the turning of *a* to the right and left, the ſhears are ſhifted from their work, to both ends of the board; when the cloth is ſhifted by the preſſure of the lever of *d*, *c*, on which E rolls, is raiſed, and, by *a*, turned left and right, E is ſhifted to its ſituation, proper to begin the work again; which is done by the preſſure of the extremity of X to the under ſide

 of

of its pin. And, for the raising the shag, the cloth is wound on a roller, and across the table or board, as in the drawing; when, by a band from Fig. 4. to the first movement, putting the cranks in motion, *l* raiseth the shag, and when *y*, by its bell, directs the handles, the small teazle frames in *l* are shifted or turned, the work being stopt for this purpose, as in shearing, X, U, W, acting on one of the steps of H, as above described, or by placing two pulleys in a narrow frame, through which the band passeth, as above also described; and, as the cloth passeth over *g*, the band of *u* is changed into its different grooves, at convenient times, that the shag may be regularly raised. In witness whereof, &c.



XLIX. *Specification of the Patent granted to Mr.* William Turner *and Mr.* John Turner, *of Lane End, in the Parish of Stoke-upon-Trent, in the County of Stafford, Potters; for a Method of manufacturing Porcelain and Earthen Ware, by the Introduction of a Material not heretofore used in manufacturing those Articles.*

Dated Jan. 9, 1800.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, we the said William Turner and John Turner do hereby describe and ascertain the nature of our said invention, and in what manner the same is to be performed, as follows; that is to say: The principle and nature of our said invention consists in reducing to a very fine powder, by grinding in a potter's mill, in the same manner as is commonly used in grinding flints, but without calcination, a certain stone or stones, or rocky substance, commonly called or known, in the county of Stafford, by the name or names of the *Tabberners Mine Rock*, *Little Mine Rock*, and *New Rock*, or one of them, and using the

powder,

powder, ſo produced, in the manner hereinafter deſcribed. This ſtone, or rocky ſubſtance, is generally found in the coal mines, in the ſaid county of Stafford, between a hard marle and an iron-ſtone rock, and contains ſiliceous and argillaceous earth, magneſia, lime, and water: it is of an aſh or greyiſh colour, but, when dry, becomes whiter; and, if burnt in a potter's oven, with the degree of heat generally uſed in burning their wares, becomes very white, without any appearance of fuſion. Any ſtone or ſubſtance correſponding with this deſcription, or of a ſimilar quality, wherever found, and whether known by the name or names of the *Tabberners Mine Rock*, *Little Mine Rock*, and *New Rock*, or by any other name or names, is the material for which we have applied for the ſaid letters patent, and which we mean to appropriate to our own uſe, in the manufacturing of porcelain and earthen ware.

The manner in which we prepare and uſe the ſaid material, in the manufacturing of porcelain, after ſuch grinding as before deſcribed, is, by firſt waſhing, and then drying it upon a potter's kiln, commonly called a *ſlip kiln*, and afterwards mixing it with an equal proportion of growan or Corniſh ſtone; which growan or Corniſh ſtone is previouſly calcined, levigated, and dried. But, in the manufacturing of the

the larger articles or pieces of porcelain, we add a ſmall portion of flint or ſiliceous earth, which is previouſly calcined, levigated, and dried, in order to give the body of thoſe articles or pieces more ſolidity, ſo that the ſame may keep their form in the burning. But the flint or ſiliceous earth, ſo prepared, muſt be uſed in different proportions, according to the ſize of the articles or pieces of porcelain intended to be manufactured. And theſe ſeveral materials, when mixed with water, are paſſed through a fine lawn ſieve, and dried to the conſiſtence of the paſte generally uſed in the manufacturing of porcelain, and afterwards formed into veſſels and other articles, and then burnt in the uſual manner.

The manner in which we prepare and uſe the ſaid new material, in the manufacturing of earthen-ware, after being ground as before deſcribed, is, by mixing it with ground flint or other ſiliceous earth, previouſly calcined, in different proportions, according to the kind or ſort of earthen-ware intended to be made, and the degree of heat which the ſame may require. The proportions we think the beſt, are from ſix to ten parts of the ſaid new material to one part of the flint or ſiliceous earth. But, although we have deſcribed what we conſider as the beſt proportions of uſing the ſaid new material, in the manufacturing of porcelain and earthen-ware, it is expreſsly to be underſtood,

underſtood, that we do not mean abſolutely to confine it to theſe proportions, inaſmuch as the proportions muſt neceſſarily vary, according to the particular article intended to be manufactured.

The advantages ariſing from the introduction of the ſaid new material into the manufacture of porcelain, as before deſcribed, are, that from its great ductility, larger pieces of that ware are more eaſily formed than heretofore, and are leſs liable to accidents in the kiln, from the moderate degree of heat required in the burning thereof, as the ſame may be burnt in the ſame kiln, and at the ſame time, with the cream-coloured or queen's-ware; and alſo, that by the raw material being found in the ſame place with the fuel, and various kinds of fire-clays uſed in the manufactory, a great expence is ſaved, and the Engliſh manufactory of porcelain and earthen-ware, is thereby rendered leſs liable to be rivalled by foreign manufactories.

The porcelain and earthen-ware produced from the ſaid new material, and manufactured as hereinbefore deſcribed, may be glazed in the manner generally uſed in glazing porcelain and earthen-ware in the Engliſh potteries. In witneſs whereof, &c.

L. *Specification of the Patent granted to Mr.* JAMES FUSSELL, *of Mells, in the County of Somerset, Iron-manufacturer, and Mr.* JAMES DOUGLASS, *of Church-street, in the County of Surrey, Engineer; for an Apparatus composed of Chains, Wheels, Rollers, and Conductors, for the Purpose of lessening Friction in raising, lowering, driving, and conducting heavy Bodies; and applicable to various other useful Purposes.*

WITH A PLATE.

Dated Nov. 28, 1799.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with, and agreeable to the true intent and meaning of, the said proviso in the said letters patent contained, I the said James Douglass do hereby declare, that the following is a particular description of the nature of this said invention, of new methods and improvements in the constructing of chains, and riggers or conductors, both in respect to principles, and to the way and manner in which they are put together and rendered practically useful, which is fully described in the above drawing, and the de-

ſcription thereof hereunder written, and conſiſts of the following principles; that is to ſay: The method and form of this chain working on a ſcale-beam principle, the fulcrum being of an oblong ſhape, the friction which attends chains in general will in a great meaſure be obviated, and its ſtrength greatly increaſed; but, when it may be required to work over a ſmall conductor, the friction will be immaterial, and the fulcrum, in that caſe, may be round. Both will work as eaſy and pleaſant as a ſtrap or rope, and are applicable to moſt purpoſes where ſtraps and ropes are now in uſe, with this advantage, that all ſtraps and ropes, eſpecially in heavy machinery, require a great power to keep tight on the ſheaves, and if not very much ſtrained, will not work at all; whereas this chain will work quite ſlack, and conſequently will not require ſo much power to drive it. Theſe chains, and conductors or riggers, will be found of great public utility, conſtructed for the purpoſe of leſſening friction, in raiſing, lowering, driving, and conducting heavy bodies; alſo, connecting ſhafts with one another, as well as multiplying ſpeed, inſtead of bevel wheels, applicable to cranes, ſteam-engines, extinguiſhing-engines, diſtilleries, chain-pumps, turning-lathes, and every other machine or engine which now requires leather ſtraps or ropes. And be it further conſidered, that chains, and conductors or riggers, on this

this principle, may be made of caſt-iron, wrought-iron, or any other metal, of which a deſcription of the above drawing remains as follows:

Fig. 1, (Plate XIV.) repreſents a ſide view of one of the double-link chains, working round two conductors, A and B, for the purpoſe of putting in motion any machine or engine that may be connected with them; and will, in a great meaſure, do away that friction which has hitherto been experienced in bracing up, ſo very tight, ſtraps and ropes for giving motion to machines or engines of various deſcriptions, particularly thoſe uſed in the different operations in the manufacturing of woollen-cloth. Chains on this principle, working round conductors of the above form, will likewiſe connect one ſhaft with another, almoſt in any direction, in a much more ſimple manner than that of bevel-wheels, and at one half the expence.

Fig 2, is a flat view of the chain, Fig. 1, working round the two conductors or riggers, fixed on the ſhafts C and D.

Fig. 3, is a repreſentation of a double chain, put together in a different manner to that of Fig. 1; it works round two conductors or riggers, fixed on the axles or ſhafts E, F, and connects the one with the other.

Fig. 4, is a ſingle-link chain, on the ſame principle as Fig. 3, and works in the ſame direction,

rection, which will be found of great uſe in moving lighter bodies.

Fig. 5, is a ſection of one of the conductors or riggers, ſhewing the end view of the plinths, pitched at proper diſtances round the circle, coming in contact with the hollow ſpaces formed in the chain, and cauſing the ſame effect as one wheel working into another, without that nicety of pitching, and trouble of trimming, which is required in moſt wheels.

Figs. 6, and 7, forms each one half of the conductor or rigger, which occaſionally may be brought together by ſcrew and nut, for the convenience of graſping ſhafts in various ſituations.

Fig. 8, is a ſection of one of the ſmall conductors or riggers, about one foot in diameter, for giving a quick motion to whatever machine or engine it may be applied to.

Fig. 9, ſhews the ſection of a conductor or rigger made of wood, whereon the caſt-iron plinths, in ſegments, are fixed around the circle for receiving the chain.

Fig. 10, is a ſmall conductor or rigger, with a collar and lever, for the purpoſe of throwing the different engines in and out of work, by means of cones, ſprings, &c. Thoſe conductors or riggers may be made from four inches to ten feet in diameter; ſo that every machine or engine

engine can be brought to any ſpeed required, by the application of them.

Figs. 11, 12, and 13, repreſent the different parts of the chain contained in Fig. 1. G, a flat view of a caſt-iron ſtud, for receiving the links on each end. H, H, the edge view of the links. I, I, two wrought-iron keys, for keeping the links in their proper places. K, is a ſide view of the caſt-iron ſtud. L, a flat view of the wrought-iron links.

Figs. 14, 15, 16, and 17, exhibit the different parts of the chain contained in Fig 3. M, forms the flat view of the caſt-iron ſtud. N, N, N, N, ſhew the different parts coming together by means of wire-pins caſt in the iron. O, O, O, O, edge views of the caſt-iron links. P, is a ſide-view of the caſt-iron ſtud. Q, a flat view of the caſt-iron links. R, R, R, R, repreſent the different parts all completely put together, which are kept in that poſition by means of a ſcrew placed in the centre, at S.

Figs. 18, 19, 20, 21, 22, and 23, repreſent the different parts of ſingle-link chains coming together on the ſame principles as before mentioned in Fig. 4.

Figs. 24 and 25, exhibit a chain on the ſame principle as Fig. 11; only obſerving, it is put together without the aſſiſtance of either ſcrews

or wrought iron keys, and will remain quite ſe-cure when working in various directions.

Fig. 26, ſhews an iron frame fixed to a beam above, with a friction-roller at the bottom, for the purpoſe of ſupporting and regulating the length of the chain, as occaſion may require.

Figs. 27 and 28, repreſent two conductors or riggers, fixed on a horizontal ſhaft T, which is put in motion by a chain working round the con-ductor U, fixed on the end of the ſhaft. W, ſhews the chain leading to a conductor, Fig. 29, driving an improved patent-mill, for the pur-poſe of raiſing and bruſhing woollen-cloth. A chain at X, on the reverſe ſide of the ſhaft T, is alſo working a machine, Fig. 30, for the pur-poſe of ſhearing and cropping woollen-cloth; for which improvements, two patents were granted in March, 1798, and another in March, 1799. In witneſs whereof, &c.

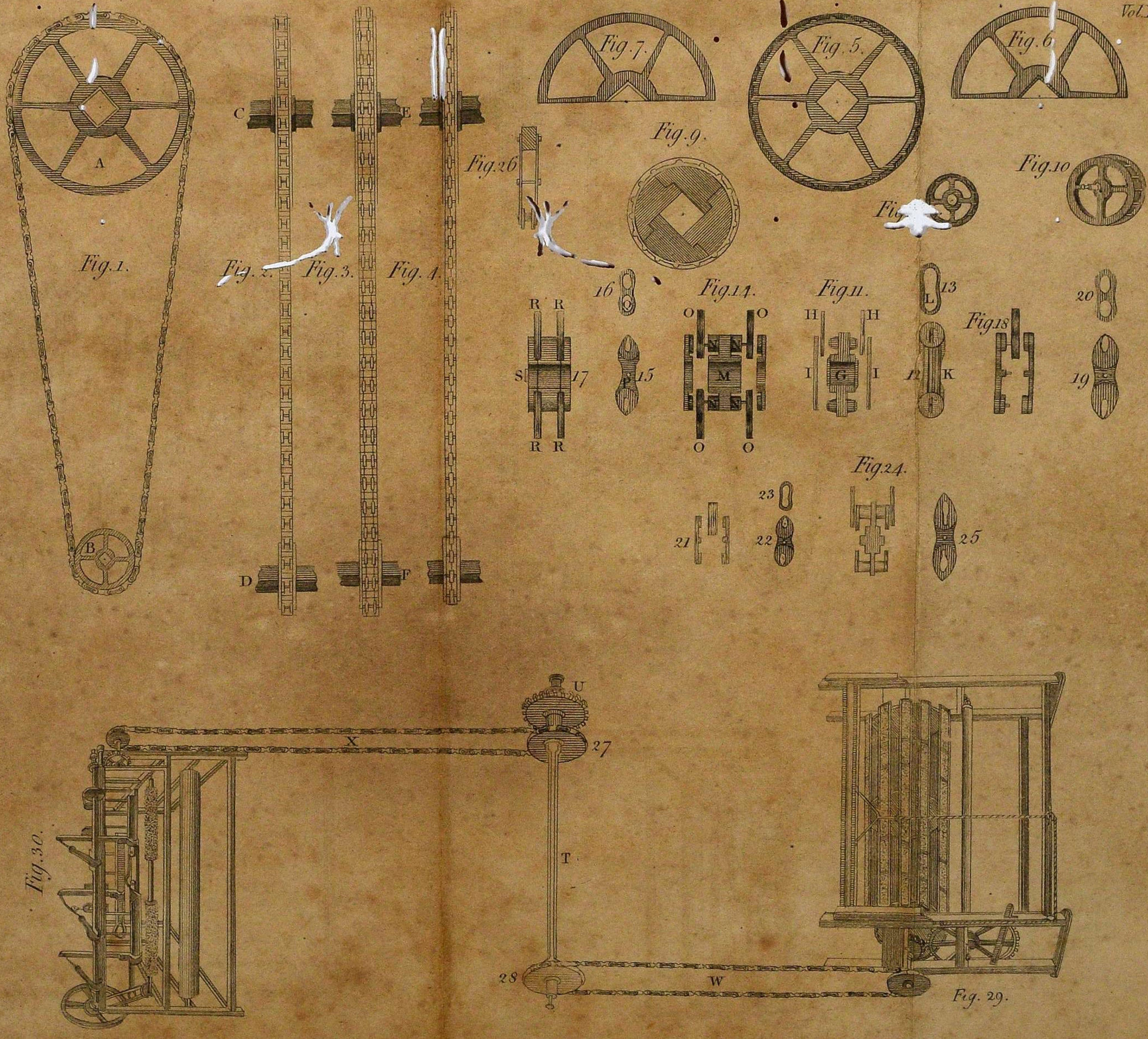


Fig. 1.
A
B
Fig. 2.
Fig. 3.
Fig. 4.
C
D
E
F
Fig. 26
Fig. 7.
Fig. 5.
Fig. 6.
Fig. 9.
Fig. 10.
Fig. 14.
Fig. 11.
Fig. 18
Fig. 24.
R
S
O
N
M
H
I
G
L
K
13
12
15
16
17
19
20
21
22
23
25
U
X
27
T
28
W
Fig. 29.
Fig. 30.

LI. *Specification of the Patent granted to Mr.* JAMES YATES, *of Bordsley, near Birmingham, in the County of Warwick, Brass-founder; for a Method of multiplying Engravings or Chasings on all Kind of Metals, particularly applicable for the Engravings or Chasings on the Ornaments of Coaches and Coach-harnesses; and for many other Purposes where Engravings or Chasings are required.*

Dated July 28, 1788.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said James Yates, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, as follows: The design is engraved on a solid block of steel, iron, copper, brass, or other mixed metal, made in any form or size required. It is then fixed in a die, of iron, steel, or other metal; which die has a ring or collar round it, so as to form a kind of dish, the ring on the outside of

of it rising higher than the engraved block; a forcer or block of metal is then impressed upon the engraving, and, with thin plates of soft tin, or lead, or mixed metal, is laid under a stamp or press, by the force of which a perfect impression is made from the engraved block. Thin plates of metal, of gold, silver, plated metal, copper, brass, or other mixed metals, are then impressed, or stamped, and the raised side of the impression of the engraving is then filled with melted metal, of lead, tin, or any other mixed metal, or hard cement, to any thickness required; so that the reverse side has the perfect appearance of the original engraved block or pattern; and any number of impressions may be taken off. For some purposes, a steel, iron, or other metal roll is engraved, of any design required, and an impression taken off, by another counter roll, of metal; and then, plates of thin metal, of any kind, are passed between the rollers, by the force of a mill, and the raised side of the impression is afterwards filled with metal, &c. as before described. In witness whereof, &c.

LII.

LII. *A new Suspension of the Magnetic Needle, intended for the Discovery of minute Quantities of Magnetic Attraction; also an Air Vane of great Sensibility; with new Experiments on the Magnetism of Iron Filings and Brass. By the Rev.* A. Bennett, *F. R. S.*

WITH TWO PLATES.

From the Philosophical Transactions of the Royal Society of London.

To manifest the various degrees of attraction between magnets and ferruginous bodies, different methods have been used. The substance to be tried has either been simply brought into contact with the magnet, or has been made to float on water, or on mercury. Needles are commonly made to rest horizontally on sharp-pointed wires; but, as an improvement on these methods, Mr. Cavallo has suspended a needle by a chain of horse-hair, consisting of five or six links, which move

move very freely in each other, and allow the needle to turn more than a whole revolution round its centre. By comparing this needle with others of the best sort in use, he found it much more sensible. Others have suspended the needle by fine threads, or silk; but, as these, on turning round a few times, will cause the needle to deviate from its meridian, by twisting, they are certainly objectionable.

After considering each of the above methods, and trying some of them, in November, 1789, I suspended a small sewing needle, by means of a spider's thread, in the cylindrical glass of my gold-leaf electrometer; and, having satisfactorily proved its magnetic sensibility, I now venture to propose this kind of suspension, as being well adapted to experiments requiring the needle to move with the least resistance.

Experiment I. From the astonishing tenuity of a spider's thread, (see Baker's Microscope made Easy, Part II. Chap. xxv.) it might be expected that it would bear very much twisting, without causing the needle to be sensibly drawn from its magnetic meridian: but, to prove it more fully, by direct experiments, I first fastened a small hair to the side of the glass in which the needle was suspended, and placed it so that the point of the needle stood exactly opposite to the point of

the hair; then I turned the needle round, by means of a magnet, about 800 times; and, on removing the magnet, I found that the needle rested exactly opposite to the hair. Thus, a spider's thread, only two inches long, by twisting 800 times, did not cause any sensible deviation.

Experiment II. A fine harpsichord-wire, three inches long, was suspended in a larger glass. This wire was previously rendered magnetic, by making it red-hot in the flame of a candle, and suffering it to cool in the direction of the magnetic meridian, whereby it acquired polarity by the influence of the earth's magnetic atmosphere alone; and, being soft, it possessed (as might be expected) but a weak directive power. The spider's thread was three inches long; and a small hair was fastened, by varnish, to the north pole of this wire, which served more accurately to distinguish its position opposite to a bit of ivory marked with degrees. This wire was turned round, as before, more than a thousand times; yet, when suffered to rest, it stood exactly at the same degree, the twist of the spider's thread having produced no sensible deviation.

Experiment III. A fine spider's thread was fastened to the spindle of a wheel used for spinning flax; the wheel was placed so that the spindle

and thread might hang perpendicularly. To the end of the thread, which was about two inches and a half long, was faſtened, by its ſmaller end, one fibre of the feather of a gooſe-quill: the lower end of the fibre reſted upon a book. The wheel was turned round, till the ſpindle had made above 18,000 revolutions. During this time, the ſpider's thread gradually became about one inch ſhorter; yet all this twiſting did not cauſe the fibre to turn round, when raiſed from the book. On turning the ſpindle about 500 times more, the thread broke, apparently by twiſting.

Several twiſted ſpider's threads were viewed by means of a very good lucernal microſcope, made by Mr. Adams, without being able to perceive any ſigns of twiſt, except where it was doubled, and which appeared like hairs growing out of the thread: yet the twiſt may be diſtinctly ſeen by the naked eye, in the ſunſhine, in ſome threads to be found amongſt trees, where the ſpider has probably been turned round by the wind, during its deſcent from one branch to another.

Experiment IV. A briſtle was ſuſpended horizontally, by a ſpider's thread ſomewhat ſtronger than the laſt; and, after turning the wheel till it produced 4800 revolutions, it ſhortened the thread from three inches to one inch: yet either end of the briſtle would move towards any warm

ſubſtance which was preſented to it, either with or againſt the direction of the twiſt.

Experiment V. Several other light ſubſtances were ſuſpended by fine ſpider's threads, and placed in a cylindrical glaſs, about two inches in diameter, ſuch as, the thinneſt part of the wing of a dragon-fly, thiſtle down, and the down of dandelion; of theſe, the laſt appeared moſt ſenſible to the influence of heat; for, when this down was faſtened to one end of a fine gold wire ſuſpended horizontally, or to one end of two bits of ſtraw joined together in the form of the letter T inverted, it would turn towards any perſon who approached it, at the diſtance of three feet, and would move ſo rapidly towards wires only heated by my hand, as very much to reſemble magnetic attraction. See Tab. XV.

Experiment VI. A bottle filled with cold water was brought near the glaſs cylinder, ſtanding in a warm room; and, ſoon after, the down of dandelion appeared to be repelled by the bottle, by turning away from it. The bottle was removed to the other ſide, and the dandelion again moved towards the oppoſite ſide.

Theſe attractions and repulſions, ſince they acted through glaſs, and at ſo great a diſtance, appeared to me at firſt to be the effects of atmoſpheres of heat, acting in a ſimilar manner

to thofe of electricity. On fhewing them to a believer in animal magnetifm, he was confident that the light fubftances were moved by the magnetic atmofphere of the body; and that there was a difference betwixt the attraction of the right hand and the left. But the doubts of my philofophical friends induced me to try the following experiment, which fully explains the matter.

Experiment VII. A piece of paper was tied over the mouth of a glafs jar about four inches in diameter. Two holes were made in the paper, oppofite to each other, and near the edge of the glafs. The jar was placed upon a table, and fuffered to ftand a confiderable time to cool, in a room without fire. I then fat near it, on the fide where one of the holes in the paper was in the nearer, and the other in the farther end of the diameter. I next filled another glafs with fmoke, and placed it with its mouth over the two holes in the paper. The fmoke was now feen to defcend through the fartheft hole; and, mixing with the air in the lower jar, plainly fhewed, that the air moved flowly towards the fide of the glafs warmed by the heat of my body.

Experiment VIII. The laft experiment proved, that the current of air moving towards, and then afcending up, the heated fide of the glafs, might turn

turn the broader end of the light ſuſpended body, like the vane of a weathercock. But, that it might ſtill more deciſively appear to be occaſioned by a current of heated air, I ſuſpended three inches of gold wire, $\frac{1}{230}$ of an inch thick, by a ſpider's thread: about an inch of the ſame wire was faſtened to the middle, and, hanging perpendicularly from the place to which the thread was attached, kept it in a horizontal poſition whilſt undiſturbed, yet ſuffered it to move up and down, like a ſcale beam, by a ſmall degree of motion in the air. Under one end of this wire heated ſubſtances were introduced; which cauſed it to move upwards, ſeeming to be repelled by them, with as much force as it was attracted when they were applied horizontally.

Having found that a ſpider's thread, only two inches and a half long, when twiſted by above 18,000 revolutions, would not cauſe a ſenſible deviation of the magnetic needle, owing to its very great tenuity, or to its glutinous quality preventing its having any tendency to untwiſt; and that light ſubſtances ſuſpended by it, and incloſed in a glaſs, were capable of being turned about, by ſo ſmall a degree of heat as that occaſioned by a perſon ſitting at the diſtance of three feet from the inſtrument, or by wires, or other ſubſtances, only warmed by holding in my hand; and that, when

when the instrument was placed in a cool room, a slight touch with the end of my finger would cause the wing of the dragon-fly, or even a bit of straw, to point exactly at the side of the glass which had been touched; there could remain no doubt of the freedom with which a magnetic needle would move when thus suspended: yet another experiment more directly proves its freedom of motion to be greater than that of former methods.

Experiment IX. Six rings of horse-hair, made exactly according to Mr. Cavallo's direction, were suspended in a cylindrical glass jar. To the lowest of these rings a spider's thread, three inches long, was attached: this thread was fastened to a gold wire, twisted round the middle of a small sewing needle. The jar was placed with its mouth downwards, and over the edge of a table, the needle hanging a little lower. After the needle and rings of horse-hair were perfectly at rest, the point of the needle was struck with the end of my finger, which caused it to turn round very swiftly; yet this twisting did not move the rings of horse-hair. A harpsichord wire, twenty-one inches long, was then suspended by ten spider's threads, to the lowest ring of the horse-hair chain: this was also frequently turned round, without moving the rings. A wire of this length was

was afterwards ſuſpended by ſpider's threads, in a proper frame, and with an ivory ſcale of degrees, with an intention to obſerve the daily variation; but it was too much influenced by heat, which I have not yet been able to obviate.

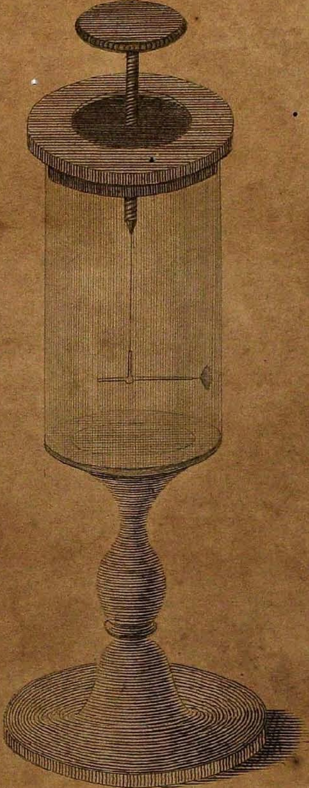
Experiment X. To the end of a fine gold wire, three inches long, and ſuſpended by a ſpider's thread in a cylindrical glaſs, was faſtened a ſmall circular bit of writing paper. Light was admitted through a ſmall hole, and alſo the focus of a large lens was thrown upon the paper, with the intention of obſerving whether it would be moved by the impulſe of light. But, though theſe experiments were often repeated, and once with the paper ſuſpended in an exhauſted receiver, yet I could not perceive any motion diſtinguiſhable from the effects of heat. Perhaps ſenſible heat and light may not be cauſed by the influx or rectilineal projection of fine particles; but by the vibrations made in the univerſally diffuſed *caloric* or matter of heat, or fluid of light. I think modern diſcoveries, eſpecially thoſe of electricity, favour the latter hypotheſis.

Experiment XI. When cold wires are introduced within the glaſs jar, and near the light ſuſpended ſubſtances, ſuch as, bits of ſtraw, or very fine wires, a very ſlight motion of the introduced ſubſtances puſhes the ſuſpended wires at the diſ-

tance

tance of an inch, appearing like repulſion; but a contrary motion draws them nearer: therefore it may be attributed to the motion of the air. Alſo, when a ſpider's thread, without any thing attached to it, is ſuſpended in a dry glaſs jar, it recedes from the electric atmoſphere of an excited glaſs tube brought ſuddenly near the outſide of the glaſs jar, whether the tube be poſitively or negatively electrified; and, when the tube is ſuddenly removed, the thread is drawn after it. This may be accounted for, by the difficulty with which the ſpider's thread changes its ſtate of electricity, being a very imperfect conductor; whence alſo, notwithſtanding its extreme fineneſs, it is unfit to be uſed as an electrometer.

TO BE CONCLUDED IN OUR NEXT.



LIII. *Conclusion of Count of* Rumford's *Inquiry concerning the Weight ascribed to Heat.*

(From Page 266.)

ADMITTING the fact stated by Dr. Fordyce, (and which my experiments had hitherto rather tended to corroborate than to contradict,) I could not conceive any other cause for the augmentation of the apparent weight of water, upon its being frozen, than the loss of so great a proportion of its latent heat as that fluid is known to evolve when it congeals; and I concluded, that if the loss of latent heat added to the weight of one body, it must of necessity produce the same effect on another, and consequently, that the augmentation of the quantity of latent heat must, in all bodies, and in all cases, diminish their apparent weights.

To determine whether this is actually the case or not, I made the following experiment.

Having provided two bottles, as nearly alike as possible, and in all respects similar to those made use of in the experiments above mentioned,

into one of them I put 4012,46 grains of water, and into the other an equal weight of mercury; and, fealing them hermetically, and fufpending them to the arms of the balance, I fuffered them to acquire the temperature of my room, 61°; then, bringing them into a perfect equilibrium with each other, I removed them into a room in which the air was at the temperature of 34°, where they remained twenty-four hours. But there was not the leaft appearance of either of them acquiring, or lofing, any weight.

Here it is very certain, that the quantity of heat loft by the water, muft have been very confiderably greater than that loft by the mercury; the fpecific quantities of latent heat in water and in mercury having been determined to be to each other as 1000 to 33; but this difference in the quantities of heat loft, produced no fenfible difference on the weight of the fluids in queftion.

Had any difference of weight really exifted, had it been no more than *one millionth* part of the weight of either of the fluids, I fhould certainly have difcovered it; and, had it amounted to fo much as $\frac{1}{700000}$ part of that weight, I fhould have been able to have meafured it; fo fenfible, and fo very accurate, is the balance which I ufed in thefe experiments.

I was

I was now much confirmed in my suspicions, that the apparent augmentation of the weight of the water, upon its being frozen, in the experiments before related, arose from some accidental cause; but I was not able to conceive what that cause could possibly be, unless it were, either a greater quantity of moisture attached to the external surface of the bottle which contained the water, than to the surface of that containing the spirit of wine, or some vertical current or currents of air, caused by the bottles, or one of them, not being exactly of the temperature of the surrounding atmosphere.

Though I had foreseen, and, as I thought, guarded sufficiently against, these accidents, by making use of bottles of the same size and form, and which were blown of the same kind of glass, and at the same time; and by suffering the bottles, in the experiments, to remain for so considerable a length of time exposed to the different degrees of heat and of cold, which alternately they were made to acquire; yet, as I did not know the relative conducting powers of ice and of spirit of wine with respect to heat, or, in other words, the degrees of facility or difficulty with which they acquire the temperature of the medium in which they are exposed, or the time taken up in that operation; and, consequently, was not *absolutely certain* as to the equality of the

temperatures of the contents of the bottles at the time when their weights were compared ; I determined now to repeat the experiments, with ſuch variations as ſhould put the matter in queſtion out of all doubt.

I was the more anxious to aſſure myſelf of the real temperatures of the bottles and of their contents, as any difference in their temperatures might vitiate the experiment, not only by cauſing unequal currents in the air, but alſo by cauſing, at the ſame time, a greater or leſs quantity of moiſture to remain attached to the glaſs.

To remedy theſe evils, and alſo to render the experiment more ſtriking and ſatisfactory in other reſpects, I proceeded in the following manner.

Having provided three bottles, A, B, and C, as nearly alike as poſſible, and reſembling in all reſpects thoſe already deſcribed ; into the firſt, A, I put 4214,28 grains of water, and a ſmall thermometer, made on purpoſe for the experiment, and ſuſpended in the bottle in ſuch a manner that its bulb remained in the middle of the maſs of water ; into the ſecond bottle, B, I put a like weight of ſpirit of wine, with a like thermometer ; and, into the bottle C, I put an equal weight of mercury.

These bottles, being all hermetically ſealed, were placed in a large room, in a corner far removed from the doors and windows, and where the air appeared to be perfectly quiet ; and, being

ing suffered to remain in this situation more than twenty-four hours, (the heat of the room (61°) being kept up all that time with as little variation as possible,) and the contents of the bottles A and B appearing, by their inclosed thermometers, to be exactly at the same temperature, the bottles were all wiped with a very clean dry cambric handkerchief; and, being afterwards suffered to remain exposed to the free air of the room a couple of hours longer, in order that any inequalities in the quantities of heat, or of the moisture attached to their surfaces, which might have been occasioned by the wiping, might be corrected by the operation of the atmosphere by which they were surrounded, they were all weighed, and were brought into the most exact equilibrium with each other, by means of small pieces of very fine silver wire, attached to the necks of those bottles which were the lightest.

This being done, the bottles were all removed into a room in which the air was at 30°, where they were suffered to remain, perfectly at rest and undisturbed, forty-eight hours; the bottles A and B being suspended to the arms of the balance; and the bottle C suspended, at an equal height, to the arm of a stand constructed for that purpose, and placed as near the balance as possible, and a very sensible thermometer suspended by the side of it.

At

At the end of forty-eight hours, during which time the apparatus was left in this ſituation, I entered the room, opening the door very gently, for fear of diſturbing the balance; when I had the pleaſure to find the three thermometers, *viz.* that in the bottle A, (which was now incloſed in a ſolid cake of ice,) that in the bottle B, and that ſuſpended in the open air of the room, all ſtanding at the ſame point, 29° F, and the bottles A and B *remaining in the moſt perfect equilibrium.*

To aſſure myſelf that the play of the balance was free, I now approached it very gently, and cauſed it to vibrate; and I had the ſatisfaction to find, not only that it moved with the utmoſt freedom, but alſo, when its vibration ceaſed, that it reſted preciſely at the point from which it had ſet out.

I now removed the bottle B from the balance, and put the bottle C in its place; and I found that *that* likewiſe remained of the ſame apparent weight as at the beginning of the experiment, being in the ſame perfect equilibrium with the bottle A as at firſt.

I afterwards removed the whole apparatus into a warm room, and, cauſing the ice in the bottle A to thaw, and ſuffering the three bottles to remain till they and their contents had acquired the exact temperature of the ſurrounding air, I

wiped

wiped them very clean, and, comparing them together, I found their weights remained unaltered.

This experiment I afterwards repeated ſeveral times, and always with preciſely the ſame reſult; the water, *in no inſtance*, appearing to gain, or to loſe, the leaſt weight, upon being frozen, or upon being thawed; neither were the relative weights of the fluids in either of the other bottles in the leaſt changed, by the various degrees of heat, and of cold, to which they were expoſed.

If the bottles were weighed at a time when their contents were not *preciſely of the ſame temperature*, they would frequently appear to have gained, or to have loſt, ſomething of their weights; but this doubtleſs aroſe from the vertical currents which they cauſed in the atmoſphere, upon being heated or cooled in it; or to unequal quantities of moiſture attached to the ſurfaces of the bottles; or to both theſe cauſes operating together.

As I knew that the conducting power of mercury, with reſpect to heat, was conſiderably greater than either that of water or that of ſpirit of wine, while its capacity for receiving heat is much leſs than that of either of them, I did not think it neceſſary to incloſe a thermometer in the bottle C, which contained the mercury; for it was evident,

evident, that when the contents of the other two bottles ſhould appear, by their thermometers, to have arrived at the temperature of the medium in which they were expoſed, the contents of the bottle C could not fail to have acquired it alſo, and even to have arrived at it before them; for, the time taken up in the heating, or in the cooling, of any body, is, *cæteris paribus*, as the capacity of the body to receive and retain heat, *directly*, and as its conducting power, *inverſely*.

The bottles were ſuſpended to the balance by ſilver wires about two inches long, with hooks at the ends of them; and, in removing and changing the bottles, I took care not to touch the glaſs. I likewiſe avoided, upon all occaſions, and particularly in the cold room, coming near the balance with my breath, or touching it, or any part of the apparatus, with my naked hands.

Having determined that water does not acquire or loſe any weight, upon being changed from a ſtate of *fluidity* to that of *ice*, and *vice verſa*, I ſhall now take my final leave of a ſubject which has long occupied me, and which has coſt me much pains and trouble; being fully convinced, (from the reſults of the above-mentioned experiments,) that if heat be in fact a *ſubſtance* or matter, a fluid *ſui generis*, as has been ſuppoſed, which, paſſing from one body to another,

and

and being accumulated, is the immediate cause of the phænomena we observe in heated bodies, (of which, however, I cannot help entertaining doubts,) it must be something so infinitely rare, even in its most condensed state, as to baffle all our attempts to discover its gravity. And, if the opinion which has been adopted by many of our ablest philosophers, that heat is nothing more than an intestine vibratory motion of the constituent parts of heated bodies, should be well founded, it is clear that the weights of bodies can in no wise be affected by such motion.

It is, no doubt, upon the supposition that heat is a substance distinct from the heated body, and which is accumulated in it, that all the experiments which have been undertaken, with a view to determine the weight which bodies have been supposed to gain, or to lose, upon being heated or cooled, have been made; and, upon this supposition (but without, however, adopting it entirely, as I do not conceive it to be sufficiently proved,) all my researches have been directed.

The experiments with *water*, and with *ice*, were made in a manner which I take to be perfectly unexceptionable; in which no foreign cause whatever could affect the results of them; and the quantity of heat which water is known to part with, upon being frozen, is so considerable, that if this loss has no effect upon its ap-

 parent

parent weight, it may be presumed that we shall never be able to contrive an experiment by which we can render the weight of heat sensible.

Water, upon being frozen, has been found to lose a quantity of heat amounting to 140 degrees of Fahrenheit's thermometer; or, which is the same thing, the heat which a given quantity of water, previously cooled to the temperature of freezing, actually loses, upon being changed to ice, if it were to be imbibed and retained by an equal quantity of water, at the given temperature, (that of freezing,) would heat it 140 degrees, or would raise it to the temperature of (32° + 140) 162° of Fahrenheit's thermometer, which is only 60° short of that of boiling water; consequently, any given quantity of water, at the temperature of freezing, upon being actually frozen, loses almost as much heat as, added to it, would be sufficient to make it boil.

It is clear, therefore, that the difference in the quantities of heat contained by the water in its fluid state, and heated to the temperature of 61° F, and by the ice, in the experiments before mentioned, was *at least* nearly equal to that between water in a state of boiling, and the same at the temperature of freezing.

But this quantity of heat will appear much more considerable, when we consider the great capacity of water to contain heat, and the great apparent

apparent effect which the heat that water loses upon being frozen would produce, were it to be imbibed by, or communicated to, any body whose power of receiving and retaining heat is much less.

The capacity of water to receive and retain heat, or what has been called its specific quantity of latent heat, has been found to be to that of gold as 1000 to 50, or as 20 to 1; consequently, the heat which any given quantity of water loses upon being frozen, were it to be communicated to an equal weight of gold, at the temperature of freezing, the gold, instead of being heated 162 degrees, would be heated $140 \times 20 = 2800$ degrees, or, would be raised to a *bright red heat*.

It appears therefore to be clearly proved, by my experiments, that a quantity of heat equal to that which 4214 grains (or about 9¾ oz.) of gold would require to heat it from the temperature of freezing water to be *red hot*, has no sensible effect upon a balance capable of indicating so small a variation of weight as that of $\frac{1}{1000000}$ part of the body in question; and, if the weight of gold is neither augmented nor lessened by *one millionth part*, upon being heated from the point of *freezing water* to that of a *bright red heat*, I think we may very safely conclude, that all attempts to discover any effect of heat upon the apparent weights of bodies, will be fruitless.

LIV. *Account of the Improvements made on his Majesty's Farms in the Great Park, at Windsor. By* NATHANIEL KENT, *Esq.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

THERE having been ſome practices in huſbandry, on his Majeſty's farms under my ſuperintendance, in Windſor Great Park, which I conceive are not generally known, and being indulged with his Majeſty's gracious permiſſion to ſtate any matter that I may diſcretionally judge proper to communicate, I am induced to lay before the public a few particulars, which ſome gentlemen and farmers, under ſimilar circumſtances, may perhaps think deſerving notice.

But, before I enter upon any particular deſcription of what I have to offer, it will not perhaps be unintereſting to know the grounds upon which his Majeſty's laſt ſyſtem of agriculture has been founded.

In

In the year 1791, the Great Park at Windſor, about 4000 acres, fell into his Majeſty's poſſeſſion. It might truly be called a rough jewel. The whole, as a natural object, was grand and beautiful, of a foreſt appearance; but the parts were crowded and indiſtinct. The ſoil was various, ſome parts clay and loam, and ſome, ſharp gravel or poor ſand; a great part of the former was covered with ruſhes and mole-hills, and the latter with fern and moſs.

About 1000 acres of the lighteſt part were ſeparated from the reſt at one extremity, and formed what is called the Norfolk Farm: about 400 acres more, at the other extremity, of a good loamy ſoil, were ſeparated, and called the Flemiſh Farm; both being named from the nature of the huſbandry meant to be adopted upon them.

The reſt (about 2400 acres) remains ſtill in plantations and park; and, though ſo much reduced, yet, from the improvements which have been made upon it, is now capable of carrying more ſtock than the whole 4000 acres did before. All the unſound wet parts have been drained by the Eſſex mode, ſo as to be rendered firm, and productive of an improved herbage. The molehills have been levelled, chiefly by dragging, and the coarſe and moſſy parts fined by repeated harrowing and rolling; (being one of the firſt improvements upon park-land of this deſcription;) beſides

befides which, a variety of beauty has been laid open, by clearing the valleys and low parts, to give a bolder effect to the woody fcenes upon the higher ground, and by making judicious openings, fo as to break ftraight lines, and feparate parts that were in fome places too heavy and fimilar; fo that the fame extent of land has now not only a much larger appearance, but exhibits a much greater variety of ground. The truth of this, every impartial perfon, who knew the place before his Majefty caufed thefe improvements to be made, muft allow. I have only to add, that though prejudice may have taken up an idea, that there has been too great a facrifice of timber in effecting thefe improvements, truth will deny it. There has not been a tree taken down, or removed, except on account of decay, or to give room for the growth of others, or to fet them off to greater advantage in picturefque appearance.

I come now to the object in view, as before hinted, which is, to ftate the motives which I am inclined to think induced his Majefty to adopt the farming fyftem upon fo large a fcale, and next to fhew the refult. Thefe, I conceive, were chiefly, to create ufeful labour for the induftrious poor in the neighbourhood, and, by trying experiments in agriculture, to excite imitation where fuccefs might encourage it.

The

The Norfolk Farm borders on that extensive waste called Bagshot-heath, hitherto considered too barren for cultivation; though large tracts, of a similar quality, have been long since rendered useful to the community in the south-west part of Norfolk. Arable land of this description is generally managed there under a five-course shift; first, wheat; second, turnips; third, barley, with seeds, which continue laid two years. But, as the seeds turn to very little account after the first year, his Majesty's, though a five-course shift likewise, of one hundred acres in a shift, is upon a much improved course of cropping; as thus, first, wheat or rye; second, the irregular shift; third, turnips; fourth, barley or oats; fifth, clover. The irregular shift, which is of great use on a light land farm, may perhaps want a little explanation. It is meant to be partly productive, and partly preparative. Forty acres of it are sown with vetches, to be fed off: forty are sown the latter end of August with rye, for early feed the next spring for the ewes and lambs; the remaining twenty acres are planted with potatoes, and the whole comes round for turnips the next year.

From the advantage of running sheep in the park, this farm has been brought surprisingly forward, considering the short time it has been cultivated; and a great part of it, which pro-

duced

duced nothing but heath and mofs, and would have been dear at five fhillings an acre, to rent, now produces crops worth more than the original fee-fimple of the land.

Brevity checks me from going farther into a general defcription; but the following particulars may deferve notice.

The comparative advantages of the labour of horfes and oxen, have been for fome time under the confideration of the public. His Majefty has unqueftionably tried the latter upon a larger fcale than any other perfon, as he does not work lefs than one hundred and eighty oxen upon his different farms, parks, and gardens, and has found them to anfwer fo well, that there is not now a horfe kept. Upon the two farms, and the Great Park, two hundred oxen are kept, including thofe coming on and going off. Forty are brought in every year, rifing three years, and are kept as fucceffion-oxen in the park; one hundred and twenty are under work; and forty every year are fatted off, rifing feven years.

The working-oxen are moftly divided into teams of fix; and one of the number is every day refted, fo that no ox works more than five days out of the feven. This day of eafe in every week, befides Sunday, is of great advantage to the animal; as he is found to do better with ordinary keep and moderate labour, than he would do with

with high keep and harder labour. In ſhort, this is the firſt ſecret to learn concerning him; for an ox will not admit of being kept in condition like a horſe, artificially, by proportionate food to proportionate labour.

Theſe oxen are never allowed any corn, as it would prevent their fatting ſo kindly afterwards. Their food in ſummer is only a few vetches, by way of a bait, and the run of coarſe meadows, or what are called leaſows, being rough woody paſtures. In winter, they have nothing but cut food, conſiſting of two-thirds hay, and one-third wheat-ſtraw; and the quantity they eat in twenty-four hours, is about twenty-four pounds of hay, and twelve of ſtraw: and, on the day of reſt, they range as they like, in the ſtraw-yards; for it is to be obſerved, that they are not confined to hot ſtables, but have open ſheds, under which they eat their cut provender, and are generally left to their choice to go in and out. Under this management, as four oxen generally plough an acre a day, and do other work in proportion, there can be no doubt but their advantage is very great over horſes, and the reſult to the public highly beneficial.

The oxen which are brought on in ſucceſſion, run the firſt ſummer in the park, and in the leaſows and temporary ſtraw-yards in the winter; by the term temporary ſtraw-yards, I would have it

 underſtood,

underſtood, that they are made in different places, ſo that the manure which they make may be as near to the ſpot where it is wanted as poſſible.

The forty oxen which go off are ſummered in the beſt paſture, and finiſhed with turnips the enſuing winter. The uſual way has been to draw the turnips, and to give them, either ſtalled, or in cribs placed in the yard, with plenty of ſtraw, to browſe and lie upon. But, laſt winter, an experiment was tried which anſwered extremely well, and will be again repeated next winter: this was, penning the oxen by day upon the turnip-land, in the manner that ſheep are penned, with this only difference, that the turnips were thrown up into cribs, inſtead of being left to be trodden into the ground; and in the nights the oxen were driven into a yard, with a temporary ſhed, well littered with ruſhes, fern, and leaves, and turnips and barley-ſtraw given to them in cribs. They thrived very faſt, and every one of them made at leaſt eight loads of good muck in the night-yard, beſides the benefit done in treading and dunging on the land in the day-time, which was very great, the ſoil being very light. The reſult of the ox ſyſtem is, that charging the ox for his agiſtment the firſt year, for the value of the graſs and turnips the laſt year, and putting what he has in three intermediate years, as an equivalent for his labour, after every allowance for riſk, each ox

will

will pay at least twenty *per cent.* profit. In what instance does a horse produce so much?

I do not allow that the ox can be used on all soils; upon a very stony soil he cannot: nor can the horse in all places be wholly excluded from husbandry; but every occupier of a large farm may at least use some oxen to very great advantage. They are all worked at Windsor in collars, as their step is found to be much more free than when coupled together with yokes; and they are found to do their work with much greater ease in collars than in yokes, which ought every where to be exploded.

The different kinds of oxen are, in some measure, suited to the soil. Upon the Norfolk Farm, which is a light soil, the Devonshire sort are used; upon the Flemish Farm, where the soil is strong and heavy, the Herefordshire; and, in the park, where the business is carting, harrowing, and rolling, the Glamorganshire. They are all excellent in their different stations.

It may not be improper to mention a very simple method which has been discovered, of first training them to the collar; it is nothing more than putting a broad strap round their necks, and fastening one end of a cord to it, and the other to a large log of wood, and letting the ox draw it about as he feeds in his pasture, for three or four days before he is put into harness;

by which means he is very much brought forward in docility.

I have before obferved, that twenty *per cent.* may be confidered as the average profit of an ox; ftating them to be bought in at 10 *l.* and allowing them to fell for 25 *l.* taking off 10 *l.* for the two years they are not worked: but, laft year, beans being of very little value, they were kept longer than ufual, by being ftall-fed with bean-meal, which anfwered very well, as they were brought to an average of nearly 30 *l.*; and one of them, a Glamorganfhire ox, originally bought for 8 *l.* (and, from his compact round make, always called the little ox,) thrived to fuch a furprifing degree, that he became too fat to be able to travel to Smithfield, and was therefore fold to Mr. Charlwood, a neighbouring butcher, for 47 *l.*

TO BE CONCLUDED IN OUR NEXT.

LV. *On the Use of Lime mixed with Gunpowder, in rending Rocks and Stones.* *By* H. D. GRIFFITH, *Esquire, of Caerhun, near Conway, North Wales.*

From the Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture, &c.

HAVING been for some time in the habit of perusing your interesting papers on agriculture and other subjects, I am induced to lay before the Society a circumstance, which, though perhaps familiarly known to them, might, if more generally divulged through the channel of their publications, be of infinite advantage to the public.

In clearing my lands of the heaps of stones with which this country every where abounds, I found the quantity of gunpowder used in the operation, to amount to a considerable sum at

the end of the year; and, as the price of this article has been increafing of late to an enormous amount, I had recourfe to an expedient, by which the expence of it has been materially diminifhed.

I weighed out two pounds of gunpowder, and one pound of quick-lime, well dried and pulverized; which, after having been thoroughly mixed with each other, I delivered to the blafter, with directions to apply it, in fimilar quantities as he would have done the gunpowder by itfelf. I then felected fix of the hardeft granites I could find for the experiment; and the effects of the explofion were precifely the fame as if gunpowder alone had been ufed. It now occurred to me, that this might be fallacious, and that a fmaller proportion of gunpowder would produce the fame effect as a larger; I accordingly ordered the man to bore holes in a fimilar number of ftones, of the fame texture and fize with the former, and to put in a lefs quantity of gunpowder, by one-third, than he would have done if it had been left to his own management. The ftones were feparated by the fhock; but the difference in the effect was manifeft to every perfon in the field: thofe with the mixture of lime and gunpowder having been much more effectually broken and fhattered than the others.

After

After the ſucceſs of this experiment, I have conſtantly adhered to the practice; and am ſo ſatisfied of its utility, that I wiſh to ſee it more generally adopted. One thing is certain, that a mixture compoſed of equal parts of quicklime and gunpowder will *explode*; and, if this mixture were uſed merely as a train of communication to the powder within the ſtone, what a national ſaving would it be in works carried on upon an extenſive ſcale, ſuch as the numerous quarries and mine works of this kingdom!

LVI. *Account of a Method of deſtroying Caterpillars on Gooſeberry Buſhes.*

From the Prize Essays of the Highland Society of Scotland.

A RECEIPT for this purpoſe was offered to be communicated to the ſociety, by William Henderſon, at Baldridge Burn, near Dumfermline, on the 6th of February, 1795, for a ſuitable reward. The propoſal was referred to a ſub-committee, of which Dr. Monro, profeſſor of anatomy in the Univerſity of Edinburgh, was chairman; who, after making trial of the receipt, gave in their report on the 1ſt of July, 1796. The receipt for the preparation, and the manner of uſing it, was in the following words.

Take one ſcots pint of tobacco liquor, which the manufacturers of tobacco generally ſell for deſtroying bugs, and mix therewith about one ounce of alum; when the alum is ſufficiently diſſolved, put this mixture into a plate, or other veſſel wide and long enough to admit of a bruſh, like a weaver's bruſh, being dipped into it; and,

as

as early in the season as you can perceive the leaves of the bushes to be in the least eaten, or the eggs upon the leaves, (which generally happens about the end of May, and which will be found in great numbers on the veins of the leaves on their under side,) you are to take the preparation or liquor, and dip the brush into it, holding the brush towards the under side of the bush, which is to be raised and supported by the hands of another person; then, by drawing your hand gently over the hairs of the brush, the above liquid is sprinkled, and thrown in small drops on the leaves: the consequence of which is, if the eggs are there, they never come forward; and, if they have already generated worms, in a minute or two after the liquor touches them, they either die, or sicken so as to fall off the bush, at least they do so upon giving it a little shake. If, upon their thus falling off, they shall not appear to be completely dead, the bush should be held up, and either a little boiling water from a watering pan thrown on them, or a bruise given them by a spade or shovel, or the earth where they lie turned over with a hoe. This preparation does not in the least injure the bushes.

The liquor here meant is generally not in the same state it is extracted from the tobacco, but is mixed, by the tobacco manufacturers, with cold water, in the proportion of four or five pints of

water to one of the original juice or essence. Therefore, any person who may purchase the juice itself, unmixed, must mix it with water in the above proportion; and the quantity of alum must be about an ounce for each Scots pint of the mixture.

Dr. Monro's report was in the following words: "I observed, along with Mr. Hamilton and Mr. Gordon, (two other gentlemen of the committee,) and two gardeners who were present, that such caterpillars as were wetted by the liquor Mr. Henderson employs, were killed in a very few minutes; and the experiment has been repeated by my own gardener, with the same effect. I have likewise found, that it kills a kind of green fly, which is very hurtful to the leaves of plumb-trees and other fruit trees. It has been very generally known, that the smoke and the juice of tobacco were pernicious to different kinds of insects and worms; but it has not, so far as I know, been employed in Mr. Henderson's manner; and, as this has the advantage of not hurting the leaves, nor the fruit, I consider it as an useful and material improvement, and well entitled to a moderate premium."

LVII. *On the Preparation of the concrete Citric Acid or Acid of Lemons. By M.* Dizé.

FROM THE *JOURNAL DE PHYSIQUE.*

ALTHOUGH Nature presents to us the acid of lemons in a ſtate nearly free, it is nevertheleſs confounded, in the juice of that fruit, with a mucilaginous extractive matter, which prevents the union of its cryſtalline particles, and from which it is impoſſible to ſeparate it by the ſimple means of evaporation and cryſtallization.

Scheele was the firſt perſon who obtained this acid in a ſolid form. In 1774, Georgius, in Sweden, and afterwards Dubuiſſon, in France, communicated ſome obſervations on the manner of concentrating and preſerving lemon juice. Although neither their labours, nor thoſe of Stahl, or of Guyton, were able to accompliſh the cryſtallization of this acid, it is nevertheleſs certain, that theſe different reſearches were of great aſſiſtance to Scheele, in his experiments reſpecting the proceſs which he has tranſmitted to us.

I profited

I profited by an opportunity which presented itself, to verify the process of Scheele on a large scale, and to pay more particular attention to an essential circumstance, which this chemist has not sufficiently explained, although it is one of the conditions necessary to the success of the crystallization of this vegetable acid. Scheele, after several unfavourable attempts, advises us to separate the extractive mucilaginous matter from the lemon juice, by uniting the citric acid to the basis of carbonate of lime; with this it forms citrate of lime, (a salt of difficult solution,) which is precipitated, while the extractive and mucilaginous matter remains dissolved in the liquor. This citrate of lime is afterwards to be decomposed by a sufficient quantity of sulphuric acid, diluted with water; taking care that an excess of acid is employed. The sulphuric acid takes the lime from the citric acid, and forms with it sulphate of lime, which is very insoluble; on the other hand, the citric acid, being set free, is dissolved in the water with which the sulphuric acid was diluted.

By means of filtration, and washing in cold water, the citric acid is completely separated from the sulphate of lime; and may afterwards be obtained in a concrete state, by evaporating it in earthen vessels, at the temperature of boiling water.

ter. I have obferved, that it is very advantageous to fufpend the evaporation every two days, in order that the fulphate of lime, which is in folution in the liquor, may be precipitated by means of the citric acid.

The citric acid which I prepared, is the produce of the juice expreffed from feveral boxes of lemons: the quantity of citrate of lime which was decompofed, was pretty confiderable, and the decompofition was made in large earthen veffels. The fulphate of lime, which refulted from the decompofition of the citrate of lime, was well wafhed in tubs of white wood. The different liquors were united, in order to be evaporated in earthen veffels, at the temperature of boiling water: they were clear, of a pale yellow colour, and contained an excefs of fulphuric acid.

As foon as the liquors were fufficiently concentrated by evaporation, the fulphuric acid began to act, and their yellowifh colour changed to a brown one, which became blackifh at the end of the operation. The mafs of cryftals which was taken out, after the liquor had grown cold, and had ftood at reft for three days, was confiderable in quantity, and of a black colour. I drained this faline mafs in wicker bafkets; at the fame time continuing the evapora-

 tion

tion and cryſtallization of the liquor which remained.

When the firſt operation was completed, as above deſcribed, the whole of the ſaline maſs was re-diſſolved in a ſufficient quantity of cold water, and then filtered through filtering-paper, laid upon ſtrainers ſtretched upon a frame. The liquor which paſſed through was more clear, but was ſtill of a dirty brown colour; and the greateſt part of the ſubſtance which had given the cryſtals a black colour, remained on the filter. The liquors were again evaporated, then left to cryſtallize, and thus gradually exhauſted of all their citric acid. The ſalt was now become yellowiſh, and its cryſtals had a more regular form.

The ſolution and filtration of the whole of the citric acid were then repeated, for the third time. The black matter depoſited on the filters, was in ſo ſmall a quantity that it merely formed a thin layer. The cryſtals of citric acid which I now obtained, were of a white colour, regular in form, and of the greateſt purity.

Scheele, who contented himſelf with merely proving that it was poſſible to obtain this vegetable acid in a ſolid form, could not determine the natural form of its cryſtals, becauſe he operated on too ſmall a quantity.

As, however, I had obtained cryſtals of as large a ſize as art has enabled us to procure from the

the moſt uſual ſaline combinations, it is eaſy to deſcribe them. They preſent, at the firſt view, rhomboidal priſms, the ſides of which are inclined to each other at angles of about 120 and 60 degrees, and are terminated at each end by a ſummit with four trapezoïdal faces, which intercept the ſolid angles.

I have before obſerved, that Scheele conſidered it as one of the eſſential conditions towards the quick cryſtallization of the citric acid, that a little more ſulphuric acid than was neceſſary for the decompoſition of the citrate of lime, ſhould be employed. The remark of this celebrated chemiſt is not followed by any explanation; but the trial which I made on a large ſcale, ſufficiently convinced me of his penetration and ſagacity; and I have no doubt, that if he had operated on as large a quantity of lemon juice as that which I uſed, he would, in the deſcription of his proceſs, have given a reaſon for the neceſſity of employing this exceſs of ſulphuric acid.

Having aſcertained that the black matter which remains on the filters, in the purification of the citric acid, conſiſted of carbon, I was convinced that it could only be formed at the expence of a conſiderable quantity of the mucilaginous parts of the lemon juice, which the citric acid took up in its combination with the baſis of the carbonate

of

of lime; and that afterwards, when the citrate of lime is decompofed, the excefs of fulphuric acid which it is neceffary to add to it, deprives the citric acid of this mucilaginous fubftance, decompofes it, and precipitates the carbonate from it, as foon as the liquors begin to be concentrated by evaporation. The ingenious experiments which Fourcroy and Vauquelin have lately publifhed, refpecting the action of fulphuric acid on vegetable fubftances, give confiderable fupport to my reafoning on the fubject.

Lemon juice, when feparated from the whole of the mucilaginous matter which is precipitated after it has been expofed for fome hours to the contact of the air, that is to fay, as it ought to be, in order to be employed either in medicine or in the arts, fhews 5 degrees of denfity, according to Baumé's areometer for falts.

100 pounds of this fame juice abforb fix pounds four ounces of carbonate of lime, in order to be faturated. The citrate of lime which is obtained, after being well wafhed and dried, weighs 20 pounds.

One pound of pure cryftallized citric acid, diffolved in a fufficient quantity of water, requires one pound of carbonate of lime for its faturation. In this experiment, the weight of the citrate of lime diminifhes in the proportion of rather

ther more than one quarter of the mafs, inftead of increafing by more than two-thirds, as in the preceding combination; whence it may be concluded, that 100 pounds of lemon juice, faithfully prepared, marking 5 degrees of denfity by Baumé's areometer for falts, contain 6 pounds 4 ounces of pure concrete acid. This ferves to explain two phænomena; firft, the increafe in weight of 13 pounds 12 ounces, which the citrate of lime acquires; fecondly, the prefence of the mucilaginous fubftance in folution in the lemon juice, which is taken up in the combination of the citrate of lime, and afterwards feparated by the excefs of fulphuric acid, which is added when this citrate of lime is decompofed.

One ounce of diftilled water diffolves one ounce and ¼ of citric acid; 13 degrees of cold are produced by this folution. A like quantity of diftilled water, when heated to 80 degrees, diffolves twice its weight of this acid. 100 parts of citric acid, diffolved in a fufficient quantity of diftilled boiling water, diffolve 50 parts of citrate of lime.

Lemonade, of an excellent tafte, and of an agreeable appearance, may be made by diffolving 40 grains of citric acid in a pint of water, and adding to it a fufficient quantity of fine fugar. Af-

terwards, an agreeable flavour may be given to it, by diſſolving in it ſome pieces of ſugar which have been rubbed on the rind of a lemon: the ſugar imbibes the eſſential oil of the lemon peel, and renders it ſoluble. It is eaſy to extract, by this means, the whole of the eſſential oil contained in the peels of ſeveral lemons: the oleo-ſaccharum reſulting from the preparation may be mixed in a mortar, with a ſufficient quantity of ſugar; and, when the mixture is made, it may eaſily be dried, by a gentle heat, and afterwards preſerved in well-cloſed glaſs veſſels. This method, by which we may at all times procure the flavour of the lemon peel, is preferable to that of employing the eſſential oil obtained by diſtillation, as fire always communicates to it a diſagreeable flavour, which perſons of a delicate taſte can eaſily diſtinguiſh.

I ſhall finiſh my obſervations on this ſubject, by pointing out ſome characters which this acid preſents, with different earthy and metallic ſolutions.

The ſolutions of acetite of magneſia, acetite of lime, and acetite of clay, of muriate of barytes, muriate of lime, muriate of clay, and muriate of magneſia, alſo the nitrates and ſulphates of theſe ſubſtances, do not undergo any change, by the action of the citric acid.

The

The muriates and nitrates of zinc, and the ſulphate, muriate, nitrate, and acetite of copper, are not decompoſed by this acid: nor has it any action on the nitrate of lead; but the acetite of lead is immediately decompoſed by it, and precipitated in a white powder. The nitrate and acetite of mercury are alſo decompoſed; and the mercurial citrate which is precipitated, is in the form of a ſcaly ſalt, of a brick colour, more or leſs deep. The citric acid turns a ſolution of acetite of iron, or one of ſulphate of iron, to a green colour.

The quantity of citric acid which I have obtained being pretty conſiderable, I intend, at ſome future opportunity, to make known the phænomena which it preſents in its different combinations.

LVIII. *Experiments respecting the Circulation of the Sap in Trees.* By M. Coulomb.

FROM THE *JOURNAL DE PHYSIQUE.*

TOWARDS the middle of April, in the year 1796, I had ſeveral large Italian poplars cut down; the ſap had already begun to riſe, and the trees were covered with budding leaves. As I was overlooking the workmen, I obſerved that one of theſe trees, which was already divided to within a few lines diſtance from the axis of the tree, made a noiſe, when cut, ſimilar to that produced by air, when it riſes in large quantities and in ſmall globules, through the ſurface of a fluid. By having ſeveral more trees, of the ſame ſort, felled, I obſerved that this noiſe, as well as the flowing of a very limpid and taſteleſs water, took place only when the trees were about half cut through. I afterwards cauſed ſeveral trees to be cut through, in a circular form, ſo that they were only ſupported by a cylinder, of from 30 to 40 millimetres in diameter, at the axis of the tree. Theſe trees, as they fell, frequently remained joined

joined to this axis, by fibres partly broken; at which time, bubbles of air were feen to come out in great abundance; infomuch that the quantity of air which came from them was incomparably greater than that of watery fap; but the laft-mentioned fluid was perfectly limpid and taftelefs.

From this experiment, I fufpected that, in large trees, the fap rifes perceptibly only near the axis of the tree which forms the medullary canal leading to the young branches, or at leaft in the veffels which are contiguous to this canal.

In order to try if my conjecture was true, I immediately caufed four or five poplars, of from three to four decimetres in diameter, to be pierced with a large auger: the opening was made at the diftance of one metre above the ground, and directed horizontally towards the axis of the tree. I obferved that, till within the diftance of two or three centimetres from the centre of the tree, the fpiral fcrew of the auger was fcarcely wetted; but, as foon as it had arrived at this diftance from the axis of the tree, the water came out in abundance; and a continual noife was occafioned by the bubbles of air, which rofe with the fap, and which burft in the opening made by the auger.

This noife continued to take place, in trees pierced in this manner, during the whole fummer;

mer; it gradually decreaſed however, and was, as may be imagined, proportionally greater, as the heat of the ſun increaſed the perſpiration of the leaves. Scarcely any noiſe could be heard during the night, or when the days were wet and cold.

From the noiſe, and from the quantity of bubbles of air which eſcape, it appears that the quantity of air, or of gas, of whatever ſort it may be, which riſes with the ſap, is, as I have already ſaid, incomparably greater than the quantity of ſap itſelf.

May it not be ſuppoſed, from the above obſervation, that the only circulation which exiſts in trees, takes place in thoſe parts which are near the central canal of the tree, and in that infinite number of medullary horizontal rays at the end of which we always ſee the buds form themſelves and expand, and eſtabliſh a medullary communication with the axis of the tree; the diameter of which communication increaſes, in proportion as the bud enlarges and becomes a branch.

I ſubmit theſe experiments to the conſideration of Botaniſts, who I hope will repeat them. They will perhaps ſerve to throw ſome light on the phyſiology of vegetables.

LIX.

LIX. *List of Patents for Inventions, &c.*

(Continued from Page 288.)

Richard Lumbert, of the parish of Wick Riffington, in the county of Gloucester, Gentleman; for improvements on the plough or machine for draining of lands. Dated February 4, 1800.

Joseph Barnett, of Birmingham, in the county of Warwick, Merchant; for a method of making buttons for wearing apparel. Dated February 4, 1800.

William Lester, of Cotton End, in the parish of Hardingstone, near Northampton, Farmer and Patent Harrow Manufacturer; for an engine or machine for the purpose of cutting hay and straw into chaff, and other useful purposes for the use of cattle. Dated February 4, 1800.

Jabez Carter Hornblower, of John's-row, City Road, in the parish of St. Luke, in the county of Middlesex, Engineer; for a method of glazing calicos, cottons, muslins, linens, &c. Dated February 4, 1800.

Phinehas

Phinehas Crowther, of the Town of Newcastle-upon-Tyne, Engineer; for a method of applying the power of a reciprocating steam-engine to the crank or rotative axis, for drawing of coals, lead, tin, &c. out of mines, &c. Dated February 28, 1800.

Richard Maullin, of Cosely, in the county of Stafford, Screw-maker; for a machine or contrivance to mould or withdraw patterns for the casting of wood, bed, and all other screws which are got up in cast-iron, brass, or other metallic compositions. Dated February 28, 1800.

Robert Stuart, at Blantyre Cotton Mills, near Glasgow, Cotton-spinner; for a method of starching and preparing cotton-yarn in that state called the cop, by which means it is at once fitted for being made into warp, on the chain of the web, without undergoing certain operations at present in use; and also that the cotton-yarn, so prepared by him in the cop, is in like manner at once fitted for the purpose of weft or woof, by which means certain expensive operations are also saved. Dated March 19, 1800.

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NUMBER LXXII.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

LX. *Specification of the Patent granted to Mr.* SAMUEL SANDY HICKLING, *of Birmingham, in the County of Warwick, Gentleman; for a Method or Methods of improving and beautifying certain Veſſels and Utenſils uſed for Chemical, Culinary, and various other Purpoſes.*

Dated Feb. 28, 1799.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that in compliance with the ſaid proviſo, I the ſaid Samuel Sandy Hickling do hereby declare, that my ſaid invention conſiſts of two parts: the nature of the firſt part of my invention I deſcribe in manner following; I improve and beautify certain veſſels and utenſils

 uſed

uſed for chemical, culinary, and various other purpoſes, made of hammered iron, or caſt iron, or caſt iron united to or mixed with other metals, by fuſion or otherways, annealed or not annealed, by lining or covering them with the following vitreous compounds; that is to ſay: I prepare my ſaid vitreous compounds, by taking ſix parts of calcined flint, two parts of a certain ſubſtance known by the name of *compoſition* amongſt the potteries in Staffordſhire, or (in place thereof) white granite, or Corniſh china-ſtone, nine parts of litharge of lead, ſix parts of borax, one part of argillaceous earth, one part of nitre, ſix parts of calx of tin, and one part of purified potaſh. This vitreous compound is particularly uſed (but not excluſively ſo) for veſſels and utenſils, from one fourth to one twelfth of an inch thick, more or leſs. Or, ſecondly, eight parts of calcined flint, eight parts of red-lead, ſix parts of borax, five parts of calx of tin, and one part of nitre. Or, thirdly, twelve parts of potter's compoſition, or Corniſh china-ſtone, eight parts of borax, ten parts of white lead, two parts of nitre, one part of white marble calcined, one part of argillaceous earth, two parts of purified potaſh, and five parts of calx of tin. Or, fourthly, four parts of calcined flint, one part of potter's compoſition, or Corniſh china-ſtone, two parts of nitre, eight parts of borax,

borax, one part of white marble calcined, half a part of argillaceous earth, and two parts of calx of tin. Whichever of the above vitreous compounds I uſe, I finely powder and well mix together; and I melt or fuſe them in a crucible, melting-pot, or other proper veſſel; and, when they are melted or fuſed, I either pour out the fluid or maſs, or ſuffer it to cool in the ſame crucible, pot, or other veſſel. When it is cold, I reduce the maſs to a powder, by pounding and trituration. I then paſs it through a ſieve, and afterwards grind it up or levigate it with water, until it is ſufficiently fine. I then mix it up with water, or water containing gum or mucilage, ſufficient to keep the powder or vitreous compounds ſuſpended in it. The veſſel or utenſil to be lined or covered, I either make a little warm or not. I then apply my vitreous compounds to parts, or to all, of the inſide or outſide ſurface, or both ſurfaces, of the veſſel or utenſil to be lined or covered, by laying it on with a bruſh, or by dipping, or by any other method or proceſs by which ſuch vitreous compounds may be regularly laid on. The veſſel or utenſil I then gradually dry; and, when dried, I introduce it into a muffle or furnace, previouſly heated to ſuch heat as is neceſſary, to fuſe or melt the vitreous compounds; or I fuſe or melt them by means of a lamp; and I continue it in ſuch heat,

till the vitreous lining or covering is regularly fufed. The proper heat is afcertained by the fhining or gloffy appearance the vitreous compounds affume. The heat of the muffle or furface I then lower; or the veffel or utenfil I remove to a place of a lefs heat. But I prepare and apply other vitreous compounds, either by fufing them together, or not, previous to levigation, that anfwer in a better or worfe degree, with other filiceous or quartzofe matters, calcined bones, calces or oxides of metals, gypfum, and alkalies or vitrifying falts; obferving, that whatever fpecies of filiceous or quartzofe matter, calces of metals, gypfum, alkalies or vitrifying falts, I ufe, I proportion them fo as to fufe or vitrify, when the veffels or utenfils require a lefs degree of heat than that at which, either by a partial calcination, by giving out air, or by fome other means, caufe, or caufes, not yet known, that change is produced which makes the vitreous compounds become imperfect, either by being fpungy, having air bubbles, or altering the colour. All or either of the above proceffes, will preferve the veffels and utenfils to which they are applied, from ruft, and from difcolouring and diftafting any liquids, or fubftances, boiled therein. It is alfo neceffary to obferve, that when the veffels and utenfils are of different weights, conftructions, and dimenfions, they require a fhorter

or

or longer continuance in the muffle or furnace; and my vitreous compounds are prepared accordingly. When greater heats ſeem neceſſary, I make my vitreous compounds leſs fuſible, by increaſing the quantities of ſiliceous and other leſs fuſible matter, in proportion to the other ingredients; and, when leſſer heats, or ſhorter continuance of the fire, ſeem neceſſary, I diminiſh the ſiliceous and leaſt fuſible matters. I give various colours to my vitreous compounds, by ſuch colouring ingredients as are uſed by enamellers. I alſo gild, tint, and paint the veſſels or utenſils covered or lined with ſuch vitreous compounds, by the ſame method or methods as enamel painters and porcelain manufacturers uſe in their reſpective manufactories.

The nature of the ſecond part of my ſaid invention, for improving and beautifying certain veſſels and utenſils uſed for chemical, culinary, and various other purpoſes, made of hammered iron, of caſt iron, and of caſt iron united with a ſemi metal called nickel, is as follows. I allay the caſt iron employed, with certain proportions of nickel, as hereafter deſcribed. I fuſe together the nickel and caſt iron, in various proportions, from forty parts iron and one part nickel, to four parts iron and one part nickel. Theſe or other proportions I uſe, according as the lining or covering of copper is meant to be more or leſs firmly adhe-

rent

rent to the veſſel or utenſil. This compound metal I then caſt into the deſired form. Theſe veſſels or utenſils, when ſo made, I immerſe or wet over, wholly or partially, with a ſolution of copper in the muriatic, vitriolic, nitrous, or other acids, (but the nitrous I prefer,) until the ſurface of the veſſel or utenſil is lined or covered with precipitated copper. I then take it out of the ſolution, and put it into clean water. I then waſh it well, and dry it immediately; and ſecure the lining or covering from tarniſhing, by oil or other varniſh. When the ſaid lining or covering is to be changed into braſs, I make an amalgam of twelve parts zinc and of five parts quickſilver, (various other proportions will do, but I think this the beſt,) which I apply to the copper lining or covering above deſcribed, by the ſame various methods that gilders of metals practiſe; or, I boil and ſtir about the veſſel or utenſil, in water containing from ten to five hundred drops of vitriolic or any other acid, more or leſs, to the gallon, (but I prefer the vitriolic or nitrous acid, and I generally uſe from fifty to one hundred drops,) and as much amalgam as will cover the ſurface of the veſſel or utenſil entirely, or ſuch part or parts as are to be covered, which may be known by taking them out for inſpection from time to time. I then waſh the veſſels or utenſils in clean water, and dry and expoſe them in a

degree

degree of heat ſufficient to drive off the mercury, which leaves the zinc united with the copper; and, when the mercury is driven off, the precipitated copper is changed into braſs. I uſe the ſame proceſs for applying theſe metallic linings or coverings to hammered iron, caſt iron, or iron in any ſtate, or mixed with other metals, by fuſion or otherways. The veſſels and utenſils for which my above invention is more particularly adapted for culinary uſes, are brewing veſſels, furnace boilers, pots, kettles, baſons, diſhes, plates, ſaucepans, ſtewpans, and fryingpans, and all thoſe uſed for baking, frying, ſtewing, toaſting, boiling, broiling, brewing, waſhing, and other culinary purpoſes. Thoſe for chemical uſes, are ſtills, retorts, baſons, and veſſels of all forms, for holding fluids, or corroſive or other ſubſtances made and uſed by chemiſts. I apply the ſecond part of my ſaid invention to the beautifying and preſerving from ruſt, pokers, tongs, fire-ſhovels, and other ſimilar utenſils. And I apply both parts of my ſaid invention for beautifying and preſerving from ruſt, iron utenſils in general, when it can be done with benefit, utility, and propriety. In witneſs whereof, &c.

LXI. *Specification of the Patent granted to Mr.* William Bolts, *late of Aldgate, but now of Cannon-ſtreet, London, Gentleman; for new Modes of improving the Form, Quality, and Uſe of Candles, and other Lights made of Tallow, Wax, Spermaceti, or any other ſolid inflammable Subſtances.*

WITH TWO PLATES.

Dated September 26, 1799.

TO all to whom theſe preſents ſhall come, &c. Now know ye, that in compliance with the ſaid proviſo, I the ſaid William Bolts do hereby deſcribe my ſaid invention, and the modes in which the ſame is to be performed, in manner and form following; that is to ſay: My ſaid invention is founded on the four following principles.

Firſt. On the fabrication of the body of ſuch candles or lights, previous to, and independant of, the wicks, which may be afterwards applied to them.

Secondly. On the application to ſuch candles or lights, after their fabrication, of moveable wicks, which

which can be applied to, or extracted from, them at pleaſure.

Thirdly. On the application to ſuch candles or lights, of fixed or ordinary wicks, at any time after the fabrication of either.

Fourthly. On the placing the inflammable ſubſtance, while in fuſion, in a cloſe veſſel, and there ſubmitting it, ſucceſſively, to the action of a vacuum, and of a preſſure ſuperior to that of the atmoſphere; which is done in the double view of extracting, by the vacuum, any elaſtic fluid that may remain hid in it under the ordinary preſſure; and of encreaſing the ſolidity and whiteneſs of the ſubſtance, by the ſuperior preſſure applied to it while cooling.

As my invention admits of, or rather requires, various forms to be given to the bodies of the candles or lights made after its principles, I have, in the drawing hereunto annexed, (ſee Plates XVI. and XVII.) delineated ſeveral of the forms which I think preferable; remarking, however, that as the forms which may be given them are almoſt innumerable, I deem it unneceſſary to enter on a more minute deſcription than is herein given.

The firſt and moſt ſimple form I think proper to employ, is repreſented at Fig. 1. Plate XVI. It is that of a ſolid cylinder, or a truncated cone, nearly approaching to a cylinder. This body,

like any other that may be adopted, is compoſed wholly of the ſubſtance that feeds the flame; as the wick, whatever be its nature or form, is to be adapted to it at a ſubſequent period.

Another form I give to my candles or lights, repreſented at Fig. 2, is that of a truncated pyramid, with an hexagonal baſe. This exterior form I employ indifferently, whatever be the interior conſtruction of the ſaid candle or light. My reaſons for it are, that it is a more graceful figure than a cylinder or a cone; and that it permits the packing of the candles or lights ſo formed, without any interſtices between them, thereby preventing their breaking on tranſportation.

The third form of my candles or lights, is that of a cylinder, or truncated cone, perforated through its axis; ſee Fig. 3, and its ſection, Fig. 9. The diameter of the perforation is determined by the ſize of the wick ſuited to ſuch candle or light.

For common uſe I prefer a cylindrical opening; but there are caſes, ſuch as that of elliptical candles, Fig. 8, where the opening ſhould be a parallelopiped, *a b*, receiving a broad and thin wick, calculated to throw a principal ſheet of light in a ſteady direction. With this form of wick I alſo made dips; and a candle of this form, whether with a permanent or moveable wick,

wick, hereafter deſcribed, will be found to emit as much light as three candles of the ordinary form.

A fourth form of my candles or lights, and the laſt which I ſhall here delineate, is that repreſented at Fig. 4. It is a candle or light compoſed of two parts; an interior cylinder *a*, and a hollow exterior one *b*, the opening in which, *c*, is greater in diameter, by about the ſeventh of an inch, than the ſaid interior cylinder. This latter is formed with a ring or moulding round its bottom, of about a quarter of an inch broad, and ſo thick as to fill exactly the hollow opening *c*, in the former, and thus to preſerve, neceſſarily, a concentric poſition when placed in it, as at *d*, Fig. 5. This, however, is only true as to its bottom part; for, all along the reſt of the length of both cylinders, there runs an annular interſtice, *e*, Fig. 5, deſtined to be filled only by the wick *f*, (to which is ſuſpended the weight *g*,) whoſe annular form produces a thin circular flame, which draws aliment from both the inner and outer cylinders, and throws out a much greater quantity of light than it would do, if condenſed into a common wick, and placed in the centre of a common candle.

Here I muſt not omit to point out a property which this laſt mentioned form admits to be

given, or rather leads to give, to my candles or lights, *viz.* that of admitting a current of air on both ſides of the circular flame juſt mentioned. It is in fact evident, that if I form the inner cylinder *a*, Fig. 4, with a longitudinal opening through its axis, as at *b*, Fig. 5, and that I permit the influx of air, which I can, to the bottom of the candle; it is, I ſay, evident, that in ſuch caſe I produce a current of air on both ſides of the flame, and my candle has all the properties, of that kind, which an Argand lamp can boaſt of. And I hereby claim the excluſive right of applying to ſuch candles the hollow glaſs cylinder, by which, in thoſe lamps, the light is ſtill brightened and embelliſhed.

The various forms of theſe my candles or lights, require forms nearly as various for the wicks and wick-ſtands by which they are to be made uſeful. Theſe wick-ſtands are ſmall inſtruments, deſtined to keep the wicks in a central poſition, whenever ſolid candles are uſed. They are ſo formed as to be placed near the top of a ſpring-candleſtick *a*, Fig. 10, when ſuch candleſtick is uſed; or fixed to the collar *b*, Fig. 11, when a ſolid candle or light is to be conſumed in a common candleſtick. When the wick-ſtand *a*, Fig. 10, is uſed, the wick is nothing elſe than a ſlack rope of cotton, wove into the fork of the wick-

ſtand,

ſtand, as is ſeen in another direction at *c*; and, when this wick and wick-ſtand are applied to the ſpring-candleſtick, Fig. 10, while the candle riſes by the effort of the ſpring, as its ſubſtance is melted by the heat, the wick continues to abſorb the liquified matter, and to give aliment to the flame. The only difference between this wick-ſtand and that repreſented at *b*, Fig. 11, is that the latter receives a ſtraight upright wick *d*, whoſe under-end is ſpread in a tuft, to reſt on and abſorb the matter; while the upper extremity aſſumes the figure of a common wick, of which it performs the functions. As to the relative motion of the wick and candle, it is in both caſes the ſame. In the firſt, the burning candle, by the action of the ſpring, comes up to the wick, which remains ſtationary; and, in the latter, the wick deſcends, by the weight of the wick-ſtand and the collar *b*, in proportion as the body of the candle is conſumed.

Fig. 15, (Plate XVII.) repreſents a form to be given to wicks, which is peculiarly advantageous when employed with the ſpring-candleſtick above mentioned. Its form is ſomething like that of a very high-crowned hat; and the horizontal part, which repreſents the brim, interpoſing itſelf between the ſubſtance of the candle and the converging part *e*, Fig. 10, of the candleſtick, ſwiftly abſorbs the liqueſcent

liquefcent matter, and prevents the fucceeding particles from being too much melted by contact with the metal, before the flame has had time to confume the fubftance actually in fufion.

But the moft ordinary and ufeful forms to be given to the moveable wick, are thofe delineated at Figs. 14 and 16. The length of this wick is from one to four inches, according to the length of the candle to be confumed; and, at the top only, it is impregnated with the fubftance the candle is made of, fufficiently to facilitate the firft ignition. It is employed in various manners, with the perforated candle, Fig. 3. Sometimes it is faftened, by a thread, to the bottom of thofe common candlefticks which poffefs the property of elevating the candle in proportion as it is confumed; and, in this view, the fpring-candleftick before mentioned becomes ufeful. Sometimes the fame thread is wound round a fmall fpring, key, fpindle, or wheel, placed at the bottom, or in any other convenient part of the candleftick, as at *a*, Figs. 17 and 18, by turning the ftud or button of which, the wick is drawn down, as the candle burns away. Sometimes it has a fmall weight hooked to it, as at *a*, Fig. 9, which weighs it down, as the candle confumes. In either of thefe cafes, if properly attended to, the wick

wick being conſtantly humectated with the melted ſubſtance, the candle will not require to be ſnuffed, except for the purpoſe of reviving the brilliancy of the flame, when, by long-continued combuſtion, the ſummit of the wick is reduced to a coal.

And here I muſt remark, that my ſyſtem of manufacturing candles or lights, with holes through their centres, admits of the giving new degrees of perfection to candles with permanent wicks; which I intend alſo to make, under the protection of this patent. It is eaſier to put the wicks into hollow candles, than into common candle-moulds; and my wicks, which are either put in dry, or previouſly impregnated, are more cylindrical, more homogeneous, and more centrally placed, than thoſe now commonly uſed; on all which circumſtances, much of the perfection of candles depends. Moreover, my dry wick, whereof only about one inch is impregnated with the ſubſtance of the candle, as before ſaid, for the ſake of the firſt ignition, has the advantage of impregnating itſelf as the candle conſumes, thereby furniſhing a centre for abſorbing any exceſs of the melted ſubſtance in the cup, which might otherwiſe run over the circumference; and hereby, the ordinary defect called guttering is prevented. Theſe my wicks likewiſe differ

differ from the uſual form, in this circumſtance: the threads are not collectively twiſted together like a rope, but are laid longitudinally parallel to each other, whereby the regular capillary flowing of the melted fluids towards the burning point is promoted, and the acceſs of the air, from the perforated centre, improves the flame. The application alſo of theſe wicks, ſubſequent to the fabrication of the candle, furniſhes two other advantages; which are, firſt, the facility of proportioning the wick to the candle, at every operation, ſo that, in the burning of the candle, there may be neither more nor leſs tallow, or other ſubſtance, melted, than what is neceſſary for complete combuſtion. This, which is the niceſt point in candle-making, may be aſcertained in a few minutes, by trials of the wick-cotton in immediate uſe, on pieces of a newly-made candle; and the reſult of the experiments can be appropriated to the whole melting, in the application of the wicks. Secondly, theſe dry wicks, previous to their application, can be impregnated with certain chemical compoſitions, which will encreaſe the brilliancy of the flame, and have other advantages.

There are various means of manufacturing the candles or lights which conſtitute the object of this patent. They may be made in common candle-

candle-moulds, employed in the ufual way, with the addition of the apparatus, hereunder defcribed, for producing the centric perforation. But I prefer making them in nefts of moulds, Fig. 6, fo formed as to be adapted, without intervals, to as many other nefts as may be found requifite for the work intended. Thefe moulds are open at both ends; and, when I want to make perforated candles, I introduce into them a broach or wire, Fig. 7, to the bottom of which is fixed a fmall pifton *a*, fo formed as to fill one end of the mould, while the top of the broach receives a fly or regulator *b*, *b*, adapted almoft to enter the other end, whereby I enfure a truly central pofition to the broach in each mould. With thefe nefts of moulds, as nearly as convenient, I fill a trough, into which I introduce the fluid fubftance, until the moulds are entirely fubmerged. Then, if I intend to make candles or lights of a common quality, I let the whole cool together, and draw them; leaving the mafs of matter, which remains between the trough and the moulds, to keep the latter fteady for a fubfequent operation.

But, if I wifh to fubmit the fluid matter to the action of the vacuum and fuperior preffure, mentioned in the former part of this fpecification, I flide the trough containing the moulds, as foon

as filled, into a caſt-iron veſſel; to which is adapted a pneumatic apparatus, with a ſafety-valve and gauge. After cloſing this veſſel hermetically, I firſt exhauſt it, keeping up the vacuum for a few minutes, by conſtantly pumping, in order to extract any elaſtic fluid contained in the melted ſubſtance, and then reſtoring the equilibrium by readmiſſion of the air. I farther, by the condenſing tube, force new air to enter, until there exiſt in the veſſel a preſſure of as many atmoſpheres as I find expedient, which is determined by the gauge. Under this ſuperior preſſure the fluid matter is permitted to cool, and acquires a degree of ſolidity which increaſes with the preſſure, although there be evidently bounds to this encreaſe.

It is needleſs to add, that it may be ſometimes adviſeable to employ the ſuperior preſſure juſt mentioned, without creating a vacuum; and that, in ſuch caſe, nothing more is neceſſary than to force the compreſſing fluid into the caſt-iron veſſel, as ſoon as it is hermetically cloſed.

And here I muſt obſerve, that pumps are not the only means I employ to produce theſe effects. I alſo create the vacuum by a barometric or torricellean column of the melted ſubſtance, or any other heavy fluid fit for that purpoſe; and I uſe the pumps above alluded to with any incom-

preſſible

pressible fluid, instead of air, as a medium of pressure. In fine, this my principle consists in the cooling of the liquified matter under a pressure, whatever be the means whereby it be obtained.

For manufacturing my perforated wax candles, I also use moulds made of glass, to which I apply the broaches, pistons, and regulators, already described. But the most expeditious mode which I employ, for making solid or perforated candles or lights, of wax and other inflammable substances, is by ejection, or squirting them, compleatly formed, through a tube, as follows. Having melted my wax or other ingredient, I pass it into a double-bottomed tempering vessel, Figs. 12 and 13, to the bottoms of which is fixed a double-barrelled forcing pump, A A, A. To this is adapted a hollow tube B, Fig. 13, in the form of a mould, whereof it performs the office. This mould-tube screws on at *b*, for the purposes of changing and clearing. It is made either cylindrical, hexagonal, oval, or otherwise, according to the forms which I chuse to give to my candles or lights; and, when perforated candles are to be made, has along its axis a steel broach, core, or triblet, *c c*, adapted to such forms, fixed on at *b*, by the circular open piece *d*, secured with cross bars and screws, so as to insure the

central poſition of ſuch broach or core, without impeding the free current of the fuſed ſubſtance. The broach is prolonged twelve or more inches beyond the end of the mould-tube, at *e*.

The degree of the temperature of the matter in fuſion proper for this operation, which is regulated by a thermometer, muſt be entertained between its melting and congealing points, and be kept up by heated water, regularly running between the two bottoms of the tempering veſſel, during the operation; and ſpunges, charged with hot water, muſt be kept applied to the tubes protruding from the bottoms of the tempering veſſel.

Under theſe circumſtances, the fuſed ſubſtance is forced, by the piſtons of the pump, in one continued ſtreaming tube, through the conducting mould-tube B, in the form of a perforated candle, and falls off at the end of the prolonged broach at *f*, in the trough, Fig. 19, into water, whereof the heat is maintained at about five degrees below the melting point of the ſubſtance under manipulation.

To counteract the reſiſtance of the water, and preſerve the longitudinal ſtraightneſs of the candle-tube in ejection, it is proper to have a hemiſpherical pipe placed under the prolonged broach at *f*, to the whole length of the trough, to re-

ceive

ceive and conduct the ejected tube; which, as this length is compleated, is cut off at *f*, and removed, to make way for the next forthcoming mass; and so on, successively, until the whole of the melted substance in the tempering vessel is worked off. The candle tubes are then passed over, from the first, into other troughs of cold water; whence, after being sufficiently cooled, they are taken up by the workmen, and cut into the lengths required for the lights or candles intended to be made. To these, when finished, are afterwards applied, either dry or impregnated permanent wicks, or the moveable ones already described.

By this mode of manipulation, I also cast an outward coating or hollow case of wax, either of a cylindrical, hexagonal, oval, or other form; which I afterwards, at pleasure, fill up, either with bodies of tallow, of exactly correspondent similar shapes and diameters, perforated for cylindrical or flat wicks, or with melted tallow, or other mixtures; thereby producing a cheaper sort of lights, having, with superior properties, all the exterior appearance of the best wax candles of the ordinary form.

Finally, when I chuse to bleach my wax or tallow candles, without waiting for the tedious performance of that operation from the action of

the atmoſpheric air, I expoſe them to the vapour or gas of oxygenated muriatic acid, introduced and confined in a cloſe chamber adapted to that purpoſe. In witneſs whereof, &c.

Additional References to Figs. 12 and 13, in Plate XVII.

g g. The lever.
h h, *h h*. The inner bottom.
i i, *i i*. The outer ditto.
k k, *k*. The working barrels, with holes to admit the melted ſubſtance.
l l, *l*. Buckets with ſpindle valves inverted.
m. Box with two hanging valves.
n. In the ſide-view, a ſtop cock.

LXII.

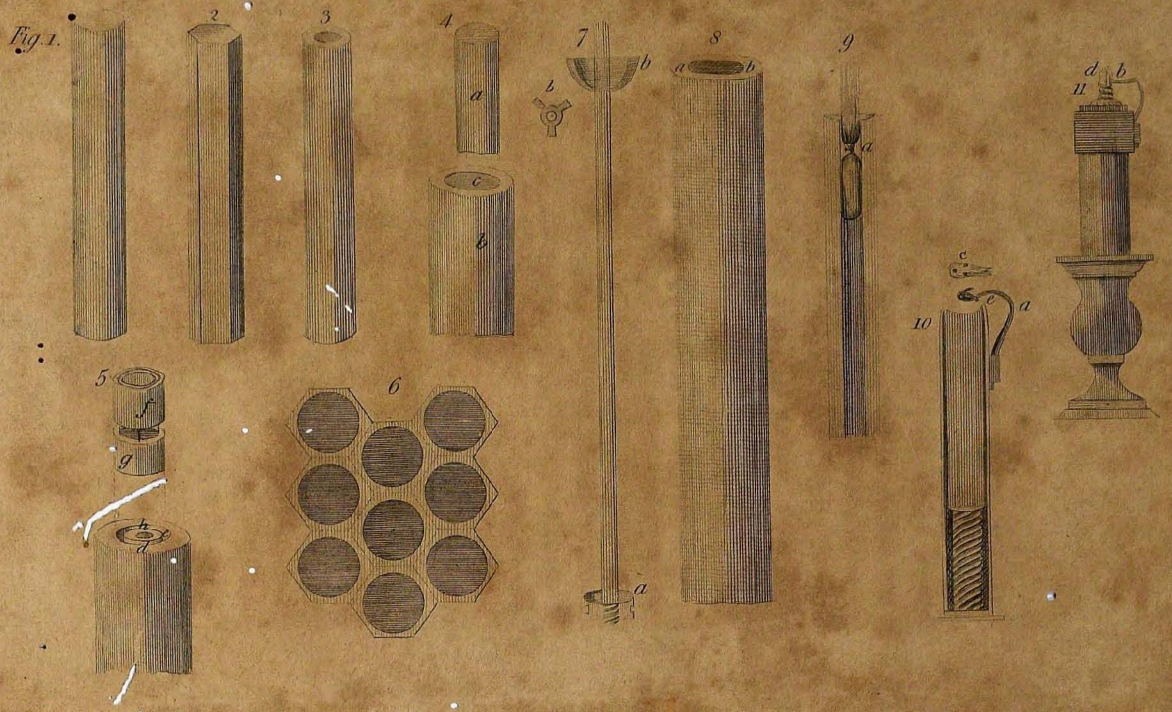


Fig. 1.
2
3
4
a
c
b
5
f
g
h
d
6
7
b
b
a
8
a
b
9
a
10
c
e
a
11
d
b

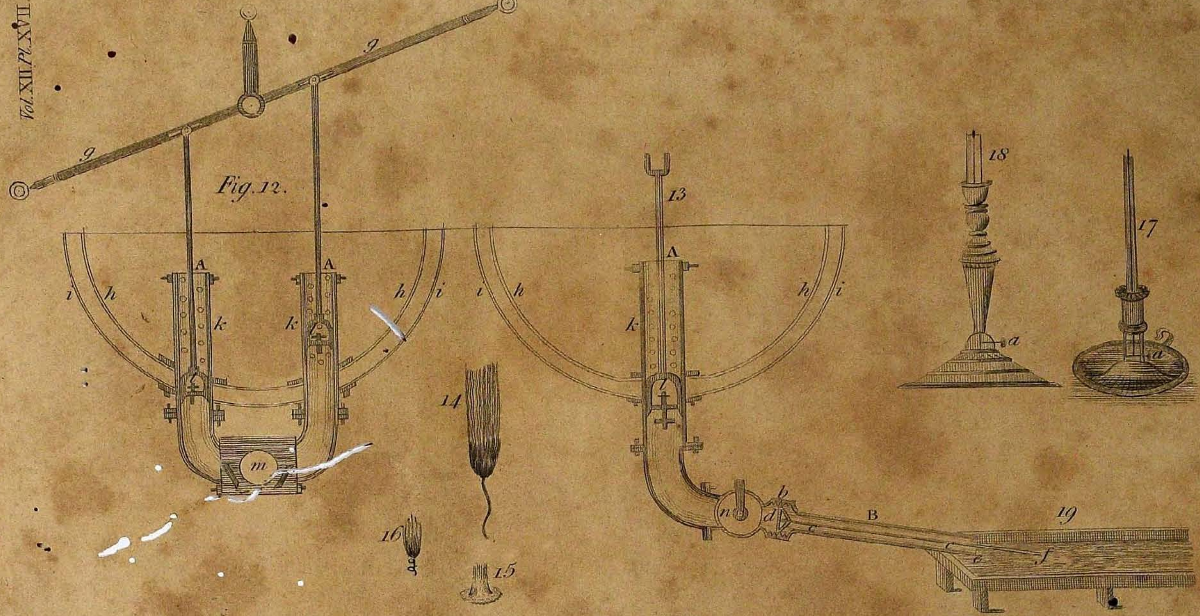


Fig. 12.
g
g
A
A
i
h
k
k
h
i
m
13
A
i
h
k
h
i
l
n
b
d
c
B
c
e
f
19
14
15
16
18
a
17
a

LXII. *Specification of the Patent granted to Mr.* Edward Coleman, *of* ——; *for an artificial Frog, which, being applied to the natural Frog of Horses' Feet, will effectually prevent contracted Hoofs, Thrushes, and Canker.*

Dated Feb. 1, 1800.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the proviso, I the said Edward Coleman do hereby declare, that my said invention is described in manner following; that is to say: As all cases of contracted hoofs, thrushes, and canker, in horses, arise from the want of due pressure to the frog, and as the frogs of horses, from ordinary shoeing, are very generally raised much above the heels of the shoe, so as to receive no pressure in the stable, it was deemed very important to apply an artificial frog, adapted to the hoofs of all horses, shod even with the most common shoes, to cover and give any degree of pressure to the natural frog only.

This

This frog may be made of iron, horn, wood, leather, and various other ſubſtances: in moſt caſes I prefer iron. In order to fix and remove the artificial frog with great facility, the toe of the iron frog extends under the toe of the ſhoe: this prevents the artificial frog from removing forwards; and, to prevent backward or lateral motion, a ſteel ſpring, or other elaſtic ſubſtance, is fitted into an irregular groove in the iron frog, and fixed under the heels of the ſhoe.

An artificial frog, thus applied, is generally retained ſufficiently ſteady; but, to fix it more firm in its ſituation, a ſtrap is paſſed through a hole in the heels of the iron frog, and buckled round the hoof. Its chief uſe is, where the frog is raiſed above the ſhoe, when the influence of the heat of the ſtable operates powerfully to induce contraction, that ſtanding on the artificial frog is more particularly wanted, to give ſuch a degree of preſſure as to preſerve the natural frog in health, and conſequently free from contraction, thruſhes, and canker. In witneſs whereof, &c.

LXIII. *Specification of the Patent granted to Mr.* Richard Elliott, *of Padſtow, in the County of Cornwall, Joiner; for a Method of covering Houſes and other Buildings with Slate, on a far more eligible and ſecure Plan.*

WITH A PLATE.

Dated March 9, 1781.

To all to whom theſe preſents ſhall come, &c. Now know ye, that I the ſaid Richard Elliott, in compliance with, and performance of, a proviſo or condition in ſuch letters patent contained, do hereby deſcribe and aſcertain the nature and uſe of my ſaid invention, which is delineated in the margin of this inſtrument, in manner following; that is to ſay:

Fig. 1. (Plate XVIII.) repreſents part of a roof covered with large ſlate rags; they are cut nearly in the form of a rhombus, and lap over each other, as expreſſed by the dotted lines; they are laid in lime or putty, and nailed or ſcrewed to the rafters; or may be fixed with wood-pins, ſcrews,

or nails, on boards. A, the ridge pole, covered either with common creaſe, or ſheet lead. B, B, B, the rafters, to which the ſlate rags are nailed or ſcrewed. The dots repreſent the nails or ſcrews by which the ſlates are fixed to the rafters.

Fig. 2. repreſents a large ſlate rag.

Fig. 3. ſhews part of a roof, or other building, covered with ſmaller ſlates, commonly called ſcantle ſlates, and may be laid either in lime or putty, on rafters, ſcrewed or nailed, or on boards, with lime or putty, nailed or ſcrewed, or fixed with wood-pins. The dotted lines ſhew the lapping of the ſtones over each other, as beforementioned.

Fig. 4. ſhews a ſcantle ſlate.

And I the ſaid Richard Elliott do hereby aver and affirm, that the particulars above ſet forth, together with the ſhape, form, and parts of a roof of a building, covered with ſlate according to my new-invented method, and of a large ſlate rag, and a ſcantle ſlate, ſo delineated in the ſaid margin, contain a full, true, and perfect deſcription of the nature of my ſaid invention, and in what manner the ſame is to be performed. In witneſs whereof, &c.

LXIV.

Fig. 1.

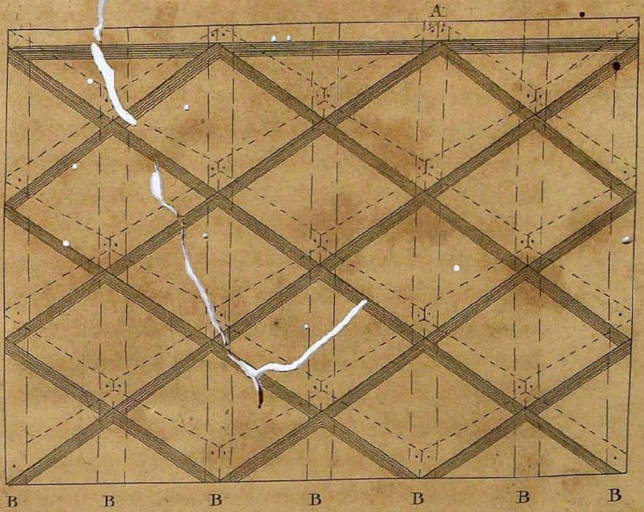


Fig. 2.

Fig. 4.

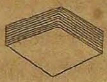


Fig. 3.

LXIV. *Conclusion of* Mr. Kent's *Account of the Improvements made on his Majesty's Farms in the Great Park, at Windsor.*

(From Page 340.)

NEXT to the advantage obtained from oxen, as much benefit as possible has been endeavoured to be derived from sheep, by means of the fold. Two ewe flocks are kept, of four hundred each. The soil being light and dry, admits of winter-folding (except when the weather is wet) upon the young clover; a practice much to be recommended, as it is productive of a great crop of clover, and prepares the land the ensuing autumn for a crop of wheat, without any farther assistance. Another excellent practice is, folding upon light land, in dry weather, immediately upon the sowing of the wheat, which may be put forward, or kept back, a fortnight or three weeks, on that account; and it is not amiss to have the fold rather large, and to give the sheep a turn or two round the fold in a morning, before they are

let out, to tread and ſettle the land, which does a great deal of good, over and above thei, dung.

A third method of folding has been found to anſwer almoſt beyond deſcription. This was firſt tried in the winter of 1793; but, from an idea of the ſhepherd, that it injured the ſheep, has been ſince diſuſed: but, as there is good reaſon to believe that there was no juſt ground for ſuch an opinion, it is meant to be revived next winter.

A dry ſheltered ſpot is ſelected, and ſods of maiden earth, a foot deep, are laid over the ſpace of a very large fold. It is then bedded thinly with ruſhes, leaves of trees, fern, moſs, ſhort ſtraw, or ſtubble; and, in hard or wet weather, the flock, inſtead of being penned upon the clover in the open fields, is put into this warmer fold, where the uſual quantity of hay is given to them in racks; every night they are ſo penned, the fold is freſh littered. When this has been continued, at intervals, during the winter, a layer of lime, chalk, rubble, or aſhes, ſix inches thick, is ſpread over the whole ſurface; and, when it has heated together, about the month of April, the whole is turned up, and mixed together, and makes the very beſt manure that can be uſed for turnips.

I have

I have been particular in describing these methods of folding, as they are not common in any place, and in some are entirely unknown: to gentlemen who have parks, and large plantations which afford abundance of leaves, this hint may be the more deserving attention.

Upon the Norfolk Farm, the land not having been yet marled or clayed, the clover is apt sometimes to fail; which is also the case elsewhere, upon the same sort of land. When this happens, his Majesty does what every other person, in a similar situation, should do; instead of letting the ground remain unproductive, the next year it is sowed with vetches, which are nearly as valuable as the clover, and wheat always grows remarkably well after them.

As to implements, the Norfolk plough is chiefly what is used; and, upon a light soil, it is certainly preferable to any other. It ploughs a cleaner furrow, by completely moving the whole body of earth, and inverts it much better than any other plough; and, to establish its superiority over the common ploughs of the neighbourhood, I need only add, that, from its construction, it is nearly the draught of an ox easier. There is likewise a Norfolk harrow, very useful for harrowing what are called brush-turnips, or any other turnips, preparatory to their being hoed.

hoed. I muſt be allowed, likewiſe, to mention the drill-roller, which conſiſts of caſt-iron rings, made at the Norwich foundery, and ſlipt on upon a round piece of wood, as an axletree. This is one of the beſt things that has ever been introduced, for the preparation of the land for any ſort of corn, where the ſoil will admit of its being uſed. By the corn being ſo well depoſited, it takes better root; and at leaſt one-fourth of the quantity uſually ſown may be ſaved.

The Flemiſh Farm, which I have before mentioned, was ſo named from an intention, at firſt, of carrying on a ſyſtem of huſbandry ſimilar to that practiſed in Flanders, which conſiſts of an alternate crop for man and beaſt; but, the ſoil being ſtrong and coheſive, upon trial, it has been found to anſwer beſt under a four-courſe ſhift, more like ſome parts of Glouceſterſhire, as thus: firſt year, wheat; ſecond, cabbage or clover; third, oats; fourth, beans. The quantity of arable land on this farm is one hundred and ſixty acres, or forty acres in a ſhift. There are two things obſerved upon this farm, which may be worth notice: the firſt is, the practice which has for theſe two years paſt been adopted, of taking off the tops of the beans juſt as the bloſſom is ſet; this not only improves the quality, but increaſes the quantity, and cauſes them to ripen

ripen sooner, which is a considerable advantage, by giving time to get the succeeding crop of wheat in, perhaps a fortnight earlier. The other is, that of sowing clover early in the spring, among twenty acres of one half of the wheat, and bush-harrowing and rolling it in. This has produced a very fair crop of clover the next year; and the other half, after the wheat, is winter and spring fallowed, and planted with cabbage. There is a double advantage resulting from this; that one half of this shift, so managed, becomes a summer crop, and the other half a winter crop; and, by observing the next year to change the parts, by sowing the clover where the cabbage was before, the clover and cabbage do not come round upon the same ground except once in eight years.

Cabbage has been tried several years; but his Majesty's husbandmen never got into the right management of it till this year; but the crop is now remarkably fine.

It will not be improper to mention, that the drum-headed cabbage is the best sort; that the seed should be sown in August; the plants first set out in November, and transplanted for good in July. The next thing to be noted is their application: they are certainly inferior to turnips for fatting, but superior in the increase of milk, either

either of cows or ewes, and therefore they are particularly good where there is a dairy, or a breeding flock of ſheep. I truſt his Majeſty will, the next yeaning ſeaſon, try an experiment of which I have high expectation, which is, to ſlice or quarter the cabbages, and feed the ewes with them, upon ſuch of the meadows as want manuring; this I flatter myſelf will be of ineſtimable ſervice to the ewes and lambs, and be the means of increaſing the next year's crop of hay conſiderably.

The true light of viewing theſe improvements is, to conſider them as a ſort of new creation to the public: for, as it is a fact not to be controverted, that the reduced number of acres in the park, from their improved ſtate, ſupport as many deer and other cattle as the whole did before, the produce obtained from the farms is all clear gain. The crop of wheat and rye, from the 140 acres ſown, upon the moſt moderate calculation, may be ſet at 3360 buſhels; and, allowing ſix buſhels to a human mouth, this gives a yearly proviſion in bread for 560 people; to ſay nothing of the fatting-off of forty oxen; the breed of 800 ſheep; and the growth of at leaſt 5000 buſhels of oats and beans; all of which, it muſt be obſerved, goes in aid of the public market, as the work is done by oxen entirely.

As

As more experiments are in future made, I may perhaps trouble the Society with an account of them, being perſuaded they cannot be regiſtered any where elſe, to give them the credit, and to excite the imitation, I flatter myſelf they may deſerve: but, for the preſent, I ſhall cloſe my obſervations upon his Majeſty's farms, with a deſcription of his mill, which I conſider as the moſt benevolent thing that can be done for the poor, and which I moſt earneſtly recommend to all gentlemen of landed property, who have like means of doing it. A ſmall over-ſhot mill is erected, and worked by the waſte water from the lake below the lodge, where a ſufficiency of corn, two-thirds wheat and one-third rye, is ground, dreſſed, and delivered to all the labourers, at ſixteen pence *per* ſtone, of fourteen pounds, in quantities ſuitable to the ſize of their families, which is the firſt of all comforts to them, and a ſaving of at leaſt twenty *per cent.* from what it would coſt them to buy it from the mealmen or ſhopkeepers.

LXV. *Conclusion of the Rev.* A. BENNETT'S *new Suspension of the Magnetic Needle, intended for the Discovery of minute Quantities of Magnetic Attraction, &c.*

(From Page 320.)

EXPERIMENT XII. It is indispensably necessary that a magnetic needle, intended for the discovery of minute quantities of magnetic attraction, should be inclosed in a proper apparatus, that the motion of the air may not disturb it, and that the substances to be tried may be brought sufficiently near, and at right angles with the point of the needle. The following instrument was constructed for this purpose, and is submitted to the approbation of those who are desirous of making further improvements in the science of magnetism. In Plate XIX, A, is the bottom of the instrument, 5½ inches square, and one inch thick, to lie horizontally on the table, and made of mahogany. B B, is a frame of the same wood, standing vertically on the middle of the square bottom, 6½ inches high, and 5½ broad.

On

On one side of the frame a piece of glass is fixed; and a piece of writing paper, gold beater's skin, or other thin substance, is pasted to the edge of the frame on the other side; so that the glass and the paper stand vertically and parallel to each other, at the distance of about half an inch, which is sufficient room for the needle, hanging by a spider's thread from the screw at C, which screw passes through the top piece D, which drops into an opening cut through the frame, and may be taken out by means of the knob of the screw at E. About 10 degrees of a circle are marked upon a bit of ivory fastened to the edge of the frame at F; and the needle, three inches long, is made of the smallest steel harpsichord wire, and is suspended by a spider's thread, also three inches long. A small tapering hair, fastened to the north pole with varnish, and extending about $\frac{1}{8}$ of an inch farther than the end of the wire, points at the degrees on the ivory; so that its motion may be very accurately distinguished, especially by the use of a lens. Round the middle of the needle a small gold wire is twisted, and its end, standing perpendicularly, is fastened to the spider's thread, to keep the needle in a horizontal position.

The method of obtaining and fastening the spider's thread, which I have used, is this: I take

a forked ſtick, conſiſting of a ſtem and two or three branches, ſtanding at about ſix inches aſunder at their ends, and, after finding a proper thread, in the corner of a building, or amongſt trees, the ends of the ſtick are ſmeared with varniſh, and each end applied to the thread, which being turned round the ends of the ſtick, may be brought away: or ſeveral forked ſticks may be placed in a room, where ſpiders are not diſturbed, and they will ſoon attach their threads to them.

When the thread is in this manner extended between the branches, the ſtick is placed upon the edge of a table, and in the ſunſhine, if poſſible, that it may be in a convenient poſition for attaching it to the needle and ſcrew, by which it is to hang. The gold wire above mentioned is then dipped in varniſh, and applied to one end of the ſpider's thread, ſo as to entangle it in the varniſh, which ſoon drying, the thread becomes faſt, and may be ſuffered to hang down, the upper end of the thread being yet faſt to the forked ſtick. The point of the ſcrew in the top piece is then dipped in varniſh, and the upper end of the thread attached to it in the ſame manner. Laſtly, the needle is gradually lowered through the opening in the top of the inſtrument, till it hangs oppoſite to the marked ivory. If the thread be

too

too long, it is eaſily ſhortened, by lifting up the top piece, touching the end of the ſcrew with varniſh, and turning it round, ſo as to wind the thread about it, till it will hang near the edge of the ivory: but, to ſet the point of the hair at the end of the needle at a more exact diſtance, after the top piece is replaced, the ſcrew is turned by its knob E, which raiſes or lowers the needle till it hangs right. A ſecond method of raiſing or lowering the needle, with leſs trouble in the conſtruction, is to uſe a ſmall braſs wire, inſtead of the ſcrew, which may paſs through a cork; or the ivory index may be made to riſe and fall by means of a ſcrew. If both ſides of the inſtrument be made of glaſs, it may be filled with ſome tranſparent fluid, which will not cauſe the metal to ruſt, as ſpirit of wine, or oil of turpentine, that the needle may move more ſteadily, and not be ſenſibly influenced by heat.

Expedients for rendering the inſtrument more portable might be eaſily contrived: but I hope no unprejudiced philoſopher will pronounce it uſeleſs, becauſe the ſpider's thread, which is ſo eaſily replaced, may break; for ſenſibility is the only property of eſſential uſe, in diſcoveries wherein a ſmall degree of magnetic attraction is to be aſcertained.

Experiment XIII. The firſt uſe I made of my needle, ſuſpended as above, was to try the polarity

rity of several iron utensils; and, as might be expected, they attracted or repelled the north end of the needle, according to their position with respect to the magnetic atmosphere of the earth. A bar of soft iron, half an inch square, and nine inches long, moved the needle very sensibly, at the distance of about three feet: longer bars moved it at a much greater distance; and, if a bar was held horizontally, near the end of the needle, and at right angles, it might be made either to attract or repel, by moving it up or down only half an inch, so as to appear to change its attraction to repulsion at command; which has surprised persons unacquainted with the importance of position with respect to the earth's magnetic atmosphere. This polarity of position may be very sensibly perceived, by presenting small nails, or smaller bits of wire, above or below the needle, or with the remote end inclining towards the north or south; which plainly demonstrates the existence of a magnetic atmosphere over the earth, where the magnetic fluid, being rarefied at one pole and condensed at the other, occasions the polar direction of the needle, of so much use in navigation.

Experiment XIV. At the request of Dr. Darwin, I repeated an experiment of Mr. Cavallo, on the increased attraction of iron filings by ef-

fervescence with diluted vitriolic acid, inserted in the Philosophical Transactions, Vol. LXXVII. According to his direction, I placed two ounces of iron filings in an earthen vessel, near the south end of the needle; then, pouring in five parts of water, and afterwards one of good vitriolic acid, a brisk effervescence ensued; but the needle could not be perceived to move. This I repeated six times, sometimes supposing it moved a little, but was not certain, and despaired of success, till I recollected of how much importance it was to place the filings in a proper direction as to the earth's magnetic atmosphere; for, hitherto, although the filings were placed at right angles with the point of the needle, yet the bottom of the vessel was as much below, as the upper surface of the filings was above it. I then took a quantity of filings tied up in a paper, and, presenting them to the needle, I found that the bottom always repelled, and the top attracted the north pole; it was therefore necessary to place the bottom of the vessel even with the needle, or rather above it, which circumstance Mr. Cavallo did not mention. I then placed the vessel at such a distance, that the needle was drawn one degree from its former position; then, on adding the water and vitriolic acid as before, the needle came about one degree still nearer; yet it appeared improbable

that

that this increased attraction should be owing to any chemical change in the filings; and, as it was so necessary to place them right, it appeared to me likely that, whilst each particle of iron was emitting bubbles of inflammable air, and thereby increasing the perpendicular height of the filings, the circumstance before mentioned would prove the only cause of such increased attraction. To verify this, I put a quantity of filings into an earthen vessel, which covered the bottom an inch deep; then, placing them so as to draw the needle two degrees from its meridian, I marked exactly where the vessel stood, and, taking it away, I mixed with the filings a quantity of sand, which raised the whole depth of the mixture to two inches; then, replacing the vessel, I found the needle drawn above four degrees from its meridian. Still more to confirm this, I placed the filings below, instead of above, the south pole, and repeated both the effervescence and mixture of sand; and thereby caused as great an increase of repulsion, as of attraction by placing them above. Each of these experiments was repeated, by placing the vessel above and below the north pole also, and the results were accordingly varied: but, when small nails were used instead of the filings, no increased attraction was produced, because the nails were too heavy to be raised higher in the vessel, although

though the effervefcence was very violent; whence I was fully convinced, that this experiment depended only on raifing the perpendicular height of the column of iron filings.

Experiment XV. To obviate the fufpicion that effervefcence might agitate the iron filings, and bring a greater number of them to that fide of the veffel which ftands contiguous to the magnetic needle, Mr. Cavallo repeated the experiment, with fix yards of fteel wire twifted in various directions, fo as to be admitted into the pot; in which cafe, the metal prefented a large furface to the acid, and was not fubject to be moved by the effervefcence. On adding the diluted vitriolic acid, the needle came fomewhat more than half a degree nearer to the pot. After confidering the influence of heat in the above experiment, and that the motion of the needle was only half a degree, it may reafonably be fufpected to be occafioned by the heat of the veffel: yet I think it may alfo be accounted for by the change of magnetifm in the twifted wire; for, after trying feveral times to produce this attraction, by pouring the diluted vitriolic acid on a number of bits of wire tied to the end of a glafs tube without twifting, I could not produce any increafed attraction; at laft, by twifting the wire, I fucceeded to produce a degree of attraction, which I thought was owing

to the expansion or untwisting of the wire during the effervescence. This opinion was strengthened by the changes of polarity I could so easily produce in softened steel wire; first, by passing it through a candle; by which it would acquire a very sensible polarity, according to the position in which it was cooled: secondly, by slightly drawing it through my fingers, held in different directions in respect to the earth's polarity: thirdly, when a wire, three inches long, was fastened to the end of a glass tube, and deprived of sensible polarity by passing through a candle at right angles to the magnetic meridian, it would become possessed of sensible polarity by a small blow with my finger on the glass tube, whilst held in a proper position: fourthly, the smallest degree of pressure between my fingers, so as to bend the wire, would give it polarity. Now, a quantity of harpsichord wire, bent in a great number of directions, will possess in some parts a polarity attractive, and in others repulsive, of the south pole of the needle; and, when placed in an earthen vessel, with its bottom somewhat above the needle, it attracts the south pole, first, by those parts which have acquired a north polarity by bending; and this attraction is strengthened by position; and position also gives north polarity to other parts, in other respects indifferent; then, during

the

the effervefcence, the heat of the mixture dilates the wire, and in fome places thereby bends it one way or other, which occafions it to acquire the magnetifm of pofition, whence there muft fometimes refult an increafed attraction. From thefe and other experiments it appears, that whenever the particles of fteel (hard enough to be capable of fixed polarity) are by any means difplaced, they admit their natural magnetifm to become rarefied and condenfed by the influence of the earth's magnetic atmofphere; and thus the effect of electrical fhocks on fteel wires may be explained; but it does not appear probable, that the action of acids increafes the magnetic attraction of iron, unlefs accompanied by other circumftances, to which an increafed attraction may be more reafonably attributed.

Experiment XVI. On reading Mr. Cavallo's experiments on the increafed attraction of iron by effervefcence, Dr. Darwin was led to inquire, whether inflammable air be magnetic. I therefore, at his requeft, caufed inflammable air to iffue through a paper tube held near the north and fouth pole of the needle alternately; the air was alfo received in a bladder, and applied; but without producing any fenfible effect on the needle.

In the feventy-fixth volume of the Philofophical Tranfactions, Mr. Cavallo has endeavoured to

prove, that brass does not owe its magnetism to iron, but to some particular configuration of its component particles, occasioned by the usual method of hardening it, which is by hammering. Some brass, he observes, will not acquire any sensible magnetism by hammering; and, in other pieces, which have often passed from the workshop to the furnace, and from the latter to the former, there is contained iron, which renders them magnetic.

Now, since some brass is evidently magnetic because it contains iron, it appears to me likely that brass whose magnetism is made sensible by hammering, contains a smaller quantity of iron, and that hammering renders it sensible, by giving it some degree of polarity. Therefore, no brass can acquire this property which contains no iron. This will appear more evident by the following experiments.

Experiment XVII. I placed an iron nail, about two inches long, in the fire, where it became red hot, and cooled, as the fire went out, in a position east and west with respect to the magnetic meridian; by which it became very soft, and, when presented towards the needle, it attracted or repelled according to its position, having no fixed polarity. The nail was then placed upon an anvil, with the point directed towards

wards the ſouth of the magnetic meridian; and, after hammering in this poſition till it was conſiderably hardened, its point poſſeſſed a fixed ſouth polarity; the other end, being thicker, did not ſeem to be altered.

Another nail was hammered with its point towards the north, which gave it a fixed north polarity. The polarity of theſe hammered nails might be inſtantly changed, by bending the point, whilſt held in a contrary poſition to that in which they were hammered. Several oblong pieces of magnetic braſs were hammered in the ſame manner, and thereby made to poſſeſs a north or ſouth polarity, according to their poſition whilſt hammered: hence it appears, that the general effect of hammering is to harden the metal, whereby it becomes, in ſome degree, a nonconductor of magnetiſm, and retains that rarefied and condenſed (and therefore more ſenſible) ſtate of the fluid which is produced by the influence of the earth's magnetic atmoſphere.

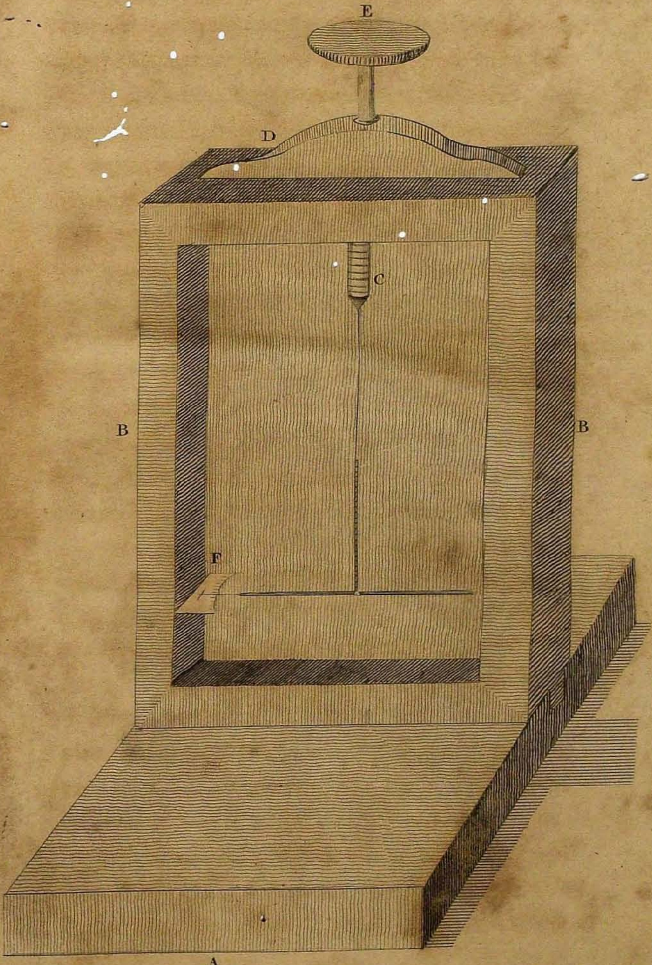
Experiment XVIII. In a ſmall crucible I placed ſix thin plates of copper, and betwixt each of them a plate of zinc; theſe, being melted, and caſt in a proper mould, produced an oblong piece of braſs, which was not ſenſibly magnetic, nor could I produce any magnetiſm in it by hammering. The ſame quantity of copper

and

and zinc were melted, with the addition of ſome ſmall bits of iron. This braſs was very ſenſibly magnetic; and, when hammered, acquired polarity, by which it more ſenſibly attracted or repelled the needle. Laſtly, a piece of copper was melted, with the addition of ſome iron, which was alſo ſenſibly magnetic. From theſe experiments I conclude, that braſs owes its magnetiſm to iron; but that it may ſometimes contain ſo ſmall a quantity as not to be ſenſible till it be hammered.

The greater ſenſibility, and eaſy conſtruction, of a magnetic needle ſuſpended by a ſpider's thread, as above deſcribed, will, I hope, contribute to extend magnetic obſervations, which may in time produce a true theory of this important branch of ſcience; while the very ſenſible air vane, from the ſame mode of ſuſpenſion, may prevent the apparent attractions and repulſions, occaſioned by currents of air, from being confounded with thoſe of magnetiſm.

LXVI.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LXVI. *Chemical Communications and Enquiries. By* ROBERT PERCEVAL, *M. D. and M. R. I. A.*

From the TRANSACTIONS of the ROYAL IRISH ACADEMY.

Marine Acid.

FOUR pounds of decrepitated ſalt were decompoſed by two pounds of vitriolic acid, (ſpecific gravity 1,845,) diluted with the ſame weight of water. By means of a tubulated receiver, the product was divided into three portions; the two firſt conſiſting each of 12 ounce-meaſures, the laſt of 10. The ſpecific gravity of theſe portions was as follows:

1ſt portion	1,181
2d ———	1,119
3d ———	1,191

On repeating the experiment, the reſult turned out ſomewhat different; the firſt and ſecond portions

tions being both ſtronger; this probably depended on the heat having been more moderate in the latter experiment, in conſequence of which, leſs marine acid air was loſt than in the former.

Specific gravity of the 1ſt portion	.	1,193
2d ———	.	1,126
3d ———	.	1,191

The general concluſion is however the ſame, namely, that what firſt and laſt comes over in diſtillation, is ſtronger than the intermediate portion; and this concluſion is confirmed by the reſult of two other experiments, the details of which, as reſembling thoſe deſcribed, need not be recited.

As marine acid air is more volatile than water, we find no difficulty in conceiving how the firſt portion of acid may be the moſt ſaturated. Why the laſt portion ſhould be ſtronger than the intermediate, is not ſo obviouſly to be accounted for; perhaps, towards the latter end of the proceſs, the vitriolic acid acts on the ſalt in a more concentrated ſtate. At firſt, I imagined that part of this acid paſſed in diſtillation, in conſequence of the increaſed heat; but, on examining the laſt portions, with a ſolution of nitrated terra ponde-

2 roſa,

rosa, I found that no precipitate was produced, but what was easily redissolved in distilled water, and which therefore I concluded did not indicate the presence of vitriolic acid *.

Nitrous Acid.

In the distillation of nitrous acid, as in that of marine, the first portion is the heaviest; but, as the distillation advances, the specific gravity of the products appears uniformly to diminish. Two pounds of nitre were decomposed by one of concentrated vitriolic acid: the product was divided into three portions; the two first consisting of 3 ounce-measures each, the last of 2½; their specific gravities were as follows:

1	1,494
2	1,485
3	1,442

As the vitriolic acid, in this process, is always in its most concentrated state, the cause on which

* On adding a solution of nitrated terra ponderosa to pure and strong nitrous or marine acid, I have observed an easily soluble precipitate to be produced. Is this an earthy salt with excess of acid, or does the acid deprive the salt of the water of its solution?

the increaſed ſpecific gravity of the laſt portion of marine acid ſeems to depend, cannot here operate.

Volatile Alkali.

In diſtilling cauſtic volatile alkali, the firſt portions that paſs in diſtillation have the leaſt ſpecific gravity. In the proceſs for cauſtic volatile alkali, according to the Edinburgh Diſpenſatory, the firſt product, amounting to one pound 100 grains, was found to be ,936, at the temperature of 58 degrees. The ſecond product, weighing one pound 1030 grains, at the ſame temperature, was ,960. Volatile alkali is always lighter than water, when perfectly cauſtic *. Alkaline air, as well as marine acid air, from its extreme volatility, ſeems diſpoſed to unite moſt copiouſly with the firſt portions of water. That theſe become lighter by uniting with it, ſeems to depend on the elaſticity of the alkaline air, which the attractive force that unites it to water is incapable of entirely repreſſing.

* This is not the caſe with the aërated volatile alkali; this liquor, obtained according to the ſame Diſpenſatory, was found, in two experiments, to be 1,042.

Vitriolic

Vitriolic Acid.

We are informed, by the moſt reſpectable authorities, that vitriolic acid has been obtained ſo ſtrong as to be more than twice as heavy as water; but, by what proceſs, I remain ignorant. I have, though perhaps miſtakenly, ſuſpected that ſuch acid was not pure, but owed its great weight to ſelenite, vitriolated lead, or vitriolated alkali, which it contained. I found the ſpecific gravity of common vitriolic acid increaſed from 1,845 to 1,892, by diſſolving, in 9 ounce-meaſures of it, 960 grains of vitriolated vegetable alkali. Six pounds of common vitriolic acid (ſpecific gravity 1,842) were diſtilled until 3134 grains came over; what remained was concentrated to 1,849. Four pounds of this concentrated acid were heated, until the bottom of the retort, and the liquor itſelf, appeared red, and were expoſed to this heat for above half an hour, during which time, copious white ſuffocating fumes paſſed in great abundance; what remained in the retort weighed two pounds 1840 grains, and was concentrated to 1,852. What came over appeared to be as ſtrong as what was at firſt put into the retort. In theſe and other ſimilar experiments, as is well

 obſerved

obſerved by Mr. Kirwan, the acid in the retort depoſits a quantity of white powder, which appears to be gypſeous; this it lets fall in ſtill greater quantity, when diluted with water. What paſſed over in the laſt mentioned experiment, although very ſtrong, was found to remain clear after dilution. Willing therefore to try what degree of concentration this pure acid would admit, I ſubjected it, together with the product of many ſimilar proceſſes, to the action of a ſtrong fire.

	Grains.
Theſe products weighed	40380
Came over	10680
Remained in the retort	29240
Loſt in vapour	460
Temperature 50 degrees. Specific gravity of what came over was	1,394
Specific gravity of what remained in the retort, and which bore dilution with diſtilled water, without having its tranſparency in the leaſt diſturbed, was	1,846

LXVII.

LXVII. *Account of some Experiments on raising Potatoes from Seed, with Reflections on the same. By Mr.* NEHEMIAH BARTLEY.

From the Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture, &c.

IT having been a prevalent opinion, that the potatoe produced from ſeed * would require ſeveral years for bringing it to a ſtate of maturity or perfection, and, from my own obſervation, having had reaſon to think it might reach maturity within the firſt year, I was, in the laſt ſpring, induced to try the experiment.

I ſhould have ſown early in the month of April, had it been in my power to procure the

* In a former letter, Mr. Bartley ſays, " a notion prevails in Lancaſhire, and ſome other potatoe countries, that after a certain period the cuttings, or off-ſets, are apt to degenerate in quality, as well as in power of producing abundant crops; whereas it is thought that potatoes raiſed from ſeed, continue to improve in both reſpects for a conſiderable number of years."

ſeed;

ſeed; but it was with much difficulty I could get any, there being none in the Briſtol ſeed-ſhops; and, by mere chance, I got a ſingle ounce at one of the London ſhops. It was not therefore till the 19th of May, that I was enabled to ſow the ſeed; which was done in drills, with two feet intervals. About a month afterwards, the plants were in a ſtate to be removed from the ſeed-bed; they were accordingly tranſplanted in drills, at the diſtance of about ſeven inches from plant to plant, with three-feet intervals. And this, I imagine, is the moſt eligible ſcale for planting the potatoe in general, whether it be the ſeedling plants, or ſhoots from the bulbs. The earth in the intervals was drawn up, from time to time, to the plants, in proportion as they advanced in growth. About the beginning of September, they ſeemed to have acquired the uſual ſize; and all the mould which the intervals afforded, had been applied to them.

About this time alſo, the plants began to put forth bloſſom; and, notwithſtanding the unfavourable circumſtance of the ſeed having been ſown ſo late, I perſuade myſelf the plants would have produced ſeed, had not a remarkably ſevere froſt intervened, at a period of the ſeaſon uncommonly early, by which they were entirely cut off: yet a great number of the bulbs had acquired a mature ſize.

To

To thoſe gentlemen who may be deſirous of purſuing this experiment, I would recommend their ſowing about the beginning of April; or even ſooner in the ſeaſon, were it not for the danger of froſt, of which this exotic plant * is very ſuſceptible.

Four ounces of ſeed would produce plants ſufficient to ſtock an acre of ground, on the ſcale I have mentioned.

The ſoil on which theſe plants were raiſed, was a deep ſandy loam, without the addition of any artificial manure.

It may be matter of future conſideration, to what extent this mode of cultivating the potatoe may ſuperſede the preſent one, of propagating by ſhoots from the bulb. But the more obvious advantages ſeem to be, the production of new, and perhaps better varieties; as well as, by a timely recurrence to the ſeed, to renovate the ſpecies, which are generally underſtood to decline in prolificacy after certain removes therefrom, and that at no very diſtant period of time.

* Would not propagating by ſeed be the moſt effectual method of naturalizing it?

LXVIII.

LXVIII. *On the Action of Cold on the acetous Acid or Vinegar.* By M. PERES.

FROM THE *JOURNAL DE PHYSIQUE.*

I DISTILLED, in a glaſs retort, and by a gentle heat, a kilogramme of good white vinegar, which had been expoſed, the preceding evening, to the uncommon degree of cold which we felt at Milan, on the 26th of laſt December. When rather more than half of it had paſſed into the recipient, which I had previouſly covered with ſnow, the apparatus was unluted, and the product was re-diſtilled, throwing away the reſiduum. This was repeated, taking always the ſame precautions, for ſix times ſucceſſively. The properties of the laſt product we obtained, were as follows: it had a milky appearance, a ſharp ſmell, an acid taſte; and its ſpecific gravity, (as far as I could judge by my hand, and by its appearance,) was equal to that of alcohol. This product was put into a bottle with a long neck, and left at reſt for the ſpace of twenty-four hours: at the end of this time, a white oily fluid had collected at the top of the bottle; it ſwam upon the

reſt

reſt of the liquor, which had ſtill a milky appearance, although nothing more ſeparated from it. There had alſo precipitated from it, a white lamellated ſubſtance, like the ſcales of the epidermis, which I had not any means of examining. A ſimilar precipitation is obſerved, when Hoffmann's Anodyne liquor is prepared with alcohol recently diſtilled.

The fluid which ſwam on the top, when ſeparated by a ſyphon, weighed two grammes and a half. Its property of taking fire when a candle was put to it, made me know that it was really ether, in every reſpect ſimilar to that which is obtained by diſtilling alcohol with ſulphuric acid; for, it is evident, from the knowledge we now poſſeſs reſpecting the action of the ſulphuric acid on vegetable ſubſtances, and particularly from the more recent diſcoveries (made by me) of the difference between the nature of the acetic and acetous acids, that (notwithſtanding what has been ſaid againſt this opinion) all kinds of ether are abſolutely the ſame, in whatever manner, and from whatever ſubſtance, they are obtained.

The experiment which I have juſt deſcribed, and which was pointed out to me by Lowitz, of Peterſburgh, (although my opinion differs in ſome reſpects from that of this chemiſt, as will be ſeen hereafter, when I mean to explain the reaſon of this difference,) leads, as I conceive, to this natural

tural conclusion, that cold not only takes from the acetous acid, when exposed to it, a part of its superabundant water, but that it really changes its nature. This proves, that the denomination of *vinegar concentrated by frost*, is erroneous; and, consequently, that the action of cold upon acetous acid, has always been misunderstood.

If, however, the only proof we had to offer of this change of its nature was a simple induction, it might be allowable not to believe it; but what follows is a farther proof of it.

When vinegar concentrated by frost is attentively examined, we immediately find, that its smell is much stronger than it was before, and its taste more acid and sharp. It is in vain to restore to it the water which cold has deprived it of; that will not cause it to resume its former qualities: it has undergone a total change. The salts which it forms in its first state are soft, attract the moisture of the air, and do not crystallize. The contrary to this takes place in its second state *. In its first state, the vinegar does not at all combine with metallic oxides: it merely oxidates the metals. In its second state, it acts upon them

* Porrati, a chemist at Milan, remarked and published a long time since, that the *terra foliata tartari*, (acetite of potash,) prepared with vinegar concentrated by frost, was not deliquescent.

forcibly,

forcibly, and forms durable salts with them, particularly with copper, with which it produces as fine crystals as those which are formed with distilled vinegar. This is proved by the use which is made of it, for that purpose, in several manufactories in Germany.

It is now necessary to shew, wherein this change consists.

What has been just said, respecting the properties which cold imparts to acetous acid, sufficiently shews, that it brings it nearer to the state of radical vinegar, by taking from it that portion of carbon which constitutes it acetous acid. Thus, cold deprives the acetous acid of its carbon; but it must be confessed, that in our climate, this deprivation is only partial *, although, from the kilogramme of vinegar which was the subject of my first experiment, I got nearly two drams of true charcoal, which were at the bottom of the vessel. The separation of carbon must be more complete in the cold climate of Russia, where Lowitz made his experiments; for which reason, he found four distillations sufficient, and

* This loss of carbon is very observable in the apples called Rennets, after having been suddenly exposed to cold; every particle of acid having been then, as it were, seized by the cold, its decomposition is more complete; besides, this apple always diffuses a smell similar to that of ether, and its inside is always of a black colour.

yet he obtained more ether than I did. All the experiments which I have made on this ſubject, (and of which I have only offered the reſults,) have perfectly well proved to me, that the acetous acid undergoes conſiderable changes by the action of cold, but that it is not, by that means, entirely brought into the ſtate of radical vinegar. I do not however mean to ſay that a new acid is formed; although, were I leſs ſcrupulous, and more poſitive, I might ſucceed in making ſuch an opinion gain belief.

In publiſhing this particular fact, I merely wiſh to direct the attention of natural philoſophers towards the chemical action which cold exerciſes upon ſubſtances, and the changes which it cauſes them to undergo. Theſe changes appeared to me particularly ſtriking in vegetable acids; I have mentioned, in another place, that by being diſtilled with ſulphuric acid, they might all be made to change from one to the other, and, conſequently, that oxygen was not what conſtituted their difference. By examining the peculiar action of cold upon each of them, I hope ſoon to give additional ſtrength to this aſſertion.

LXIX. *On the Purification of Phosphorus. By Count* Moussin Puschkin.

FROM THE *ANNALES DE CHIMIE.*

THE intention of this is to describe a method of clarifying phosphorus, not yet, I believe, mentioned by any author; the discovery of which I therefore consider as belonging to me.

Thinking it probable that the substances which give colour to phosphorus arose from the charcoal, and, consequently, were of a vegetable nature, I wished to try what would be the effect of the oxygenated muriatic acid; but, not having any of it ready prepared, I resolved to make use of an aqua regia composed of equal parts of nitrous acid and muriatic acid. My apparatus consisted of a long-necked phial, which held from four to five ounces of water. I had by me some phosphorus, which had served to precipitate copper, and which was so loaded with a coaly substance, that it was quite black. I poured, on three drams of this phosphorus, one ounce of the aforesaid

aforesaid aqua regia, and I melted the former, by means of a wax candle. The heat having brought the phosphorus into a liquid state, I shook the phial strongly, to increase the points of contact: in a few moments, the black colour of the phosphorus changed to that of yellow wax, and afterwards to that of white wax. Being left some time at rest, and before it was quite cool, it became semi-transparent; but there might be perceived in the phosphorus, a white flocculent matter, which had an earthy appearance. I decanted the aqua regia, and washed the phosphorus with cold water; it then assumed the appearance of very fine white wax. Having poured some more aqua regia upon it, and repeated the operation, the mass became beautifully transparent, and had almost entirely lost its colour. I again decanted the aqua regia, which had acquired a fine yellow colour, and seemed to have acted slightly upon the heterogeneous substances which the phosphorus contained. I poured on the mass some boiling water; it immediately lost its transparency, and was covered with a pellicle of a reddish yellow colour; some air was then disengaged, which raised the pellicle, forming bladders in it. Having decanted the water, and washed the mass several times, I formed it into sticks, according to the usual method, in water made pretty

pretty hot, which I ſtirred gently with a glaſs tube; there was gradually ſeparated a yellow pellucid ſubſtance, which I took off by means of a pair of ſciſſars, after having taken the ſticks of phoſphorus out of the glaſs funnel, which ſerved as a mould.

I repeated this operation ſeveral times, taking care always to ſeparate the yellow ſubſtance which was depoſited at the top of the ſticks; I at laſt ſucceeded in obtaining my phoſphorus of a pearly white, and nearly tranſparent. I imagine, nevertheleſs, that by employing the oxygenated muriatic acid, and repeating the operation more frequently, and upon larger maſſes, the phoſphorus might be obtained as clear as water.

In order to try whether the aqua regia had decompoſed any part of the phoſphorus, I poured on that which I had decanted, ſome ſolution of mercury; there was immediately formed a white precipitate, which I believe to be phoſphate of mercury. The above is certainly the eaſieſt method of clarifying phoſphorus; but I believe that a conſiderable portion of it is decompoſed.

P. S. I think it proper to add, as a ſupplement to my method of purifying phoſphorus, that when it is melted in a glaſs funnel, to form it

it into ſticks, it ſhould previouſly be deprived of every heterogeneous ſubſtance, by means of a quill at the top of which is left about an inch of the feathered part. By the help of this ſort of bruſh, (which is to be gently ſtirred about in the melted phoſphorus, below the hot water of the funnel, the tube of which is alſo ſurrounded by very hot water,) we may, in the ſpace of fifteen or twenty minutes, render the phoſphorus as tranſparent as the pureſt water; which tranſparency, if the phoſphorus cooled very ſlowly, it preſerves in a conſiderable degree, ſo as to have more the appearance of glaſs which is rather milky, than of phoſphorus. It is neceſſary to have alſo at hand a veſſel filled with warm water, into which the quill (which is to be taken out from time to time) is to be plunged, in order to free it from the impure phoſphorus, which ſticks to its feathers; a little practice will ſoon render the management of this part of the proceſs very eaſy.

LXX. *Account of the Proceſs uſed by* Mr. ACHARD, *for extracting Sugar from Beet Root, as communicated by him, in a Letter to* Mr. VAN MONS.

FROM THE *ANNALES DE CHIMIE.*

MY labours reſpecting the fabrication of European ſugar have prevented my writing to you ſooner. They have employed me, and ſtill employ me, ſo much, that I have very little time to ſpare for other objects; but, as I know that the ſubject is intereſting to you, I am anxious to take the firſt opportunity of giving you ſome account of it.

The ſpecies of beet proper for making ſugar is the *Beta Vulgaris* of Linnæus; but all the varieties of that ſpecies are not equally proper. That of which the inſide is white, the ſkin pale red, and the root long and ſpindle-ſhaped, is the beſt. Every kind of beet yields ſugar, but that above deſcribed ſhould be made choice of, when we wiſh to fabricate this ſubſtance advan-

 tageouſly;

tageoufly; in other refpects, the quantity of fugar furnifhed by the root depends entirely on the mode of cultivation *.

It follows, from the procefs on the fabrication of fugar from beet root, which I executed under the infpection of a committee appointed by the king, (of Pruffia,) that the beft method is, to boil the root (with the fkin, as it is taken out of the ground, and without any other preparation than that of carefully taking away the leaves and the heart) in water, till it is fo foft that it may be penetrated by a ftraw. A fhort boiling is fufficient to produce this degree of foftnefs, which is very well known to confectioners, and is given to feveral forts of fruits, before they are preferved. The beet root, after cooling, is divided, and cut into flices, by means of the machine made ufe of by hufbandmen for dividing potatoes for the ufe of cattle. This machine is defcribed, and a figure of it given, in Bufch's publication, intituled, *Ueberficht der fortfchritte in wiffenfchaften, kunften, manufacturen, und handwerken, von Oftern* 1796 *bis Oftern* 1797. Erfurt 1798. This method of dividing the root is the

* A defcription of the method of cultivation recommended by Mr. Achard, is printed in our eleventh volume, page 131; fome remarks upon it are given in the fame volume, page 209.

beft

beſt I have hitherto diſcovered. Two men, with the aſſiſtance of the machine, can cut nearly 100 lb. of roots into very thin ſlices, in three minutes.

In order to extract the juice from the roots after being ſliced, they are ſubmitted to the action of a preſs, which ought to act very ſtrongly, that as much juice as poſſible may be drawn from them. The pulp remaining in the preſs ſtill contains a conſiderable portion of ſugar, which it is worth while to extract from it. For this purpoſe, the pulp is to be mixed with a ſufficient quantity of water, and, after twelve hours, the liquor is to be preſſed out. After this ſecond extraction, there ſtill remains in the pulp a ſufficient quantity of ſaccharine matter to furniſh, advantageouſly, by means of fermentation, either brandy or vinegar.

The liquors obtained by expreſſion are to be mixed together, then ſtrained through flannel, and afterwards evaporated, by continual boiling, to about two-thirds. They are then to be paſſed a ſecond time through a woollen cloth, or through a very cloſe kind of cloth made uſe of in refineries; and the ſtrained liquor is to be boiled, in a veſſel ſmaller than the firſt, till it is reduced to one half.

The liquor muſt afterwards be ſtrained a third time, and boiled, in a ſtill ſmaller veſſel, to the

consistence of a thin syrup. It is here necessary to observe, that by giving the syrup too thick a consistence, there is a risk of spoiling the whole.

This syrup, after being poured into shallow earthen vessels, which present a large surface to the air, is to be placed in a stove heated to from 80 to 100, or even to 120 degrees, of Fahrenheit, that it may crystallize. During this insensible condensation of the syrup, the crystalline crust which is formed on its surface, is now and then to be broken; this, by assisting the evaporation, very much hastens the crystallization. From the moment it is observed that, instead of the crystalline crust, there forms on the top of the syrup a thick and gummy pellicle, which does not appear granulated, it is a sign that the substance no longer crystallizes, but merely grows dry, and the evaporation should then be stopped. What remains is a mixture, more or less thick, of a crystalline substance and a fluid but viscid matter.

To separate the crystallized sugar from the glutinous extract, the whole must be put into a bag made of close cloth, and previously wetted; it must then be submitted to the action of a press, gradually increased. The sugar remains in the bag, and the extractive part passes through it.

This

This ſugar, after being dried, is a yellow muſcovado, compoſed of regular cryſtals, and, when pulverized, forms a white powder of a very good taſte; it is perfectly ſweet, and may be applied to a number of purpoſes for which refined ſugar is uſed. By refining this muſcovado, ſugar of any quality that is wiſhed for may be obtained; the operation being repeated, according to the degree of purity deſired.

The whole of the waſte parts ariſing from this proceſs, that is to ſay, the root which has been preſſed, the liquor which paſſes through the bag upon preſſing the cryſtallized ſugar, the waſhings, &c. &c. are all very uſeful, and a great quantity of very good rum or brandy may be procured from them, which may be uſed in making the fineſt *liqueurs*.

The muſcovado, in the ſtate in which it is obtained from the firſt operation, coſts about one groſchen and a half, of Pruſſia, (about two-pence halfpenny,) *per* pound, without reckoning all the advantages which may be derived from making uſe of the waſte parts. By taking theſe into the account, and bringing the manipulations to greater perfection, which I ſhall endeavour to accompliſh this winter, I am perſuaded, that our European muſcavado will not coſt more than half this price, or nine fennings, (about five farthings);

things); or, even in countries in which fuel is much dearer, one groschen, (about seven farthings).

The distillation of spirit from the waste-parts is a matter of great importance; as by that means a great saving of grain will take place; and the making of sugar from the beet root, which will deliver Europe from an oppressive monopoly, becomes, on that account, still more interesting.

I am now endeavouring to discover a method by which the juice of the roots may be poured, after being sufficiently condensed, into moulds or forms, in order that it may acquire immediately the figure of a sugar-loaf, and that it may, by claying, become perfectly white in one operation. I have already found several methods by which it appears that this end may be obtained by a very short process. This new manipulation will very much facilitate the making of the sugar, and will consequently diminish the price of it.

LXXI.

LXXI. *List of Patents for Inventions, &c.*

(Continued from Page 360.)

Edward Steers, of the Inner Temple, London, Esquire; for a machine to be applied to boats or vessels, for the purpose of moving them along with ease and celerity. Dated March 19, 1800.

James Wood, of Hart-street, in the parish of St. Paul, Covent Garden, in the county of Middlesex, Musical Wind-Instrument-maker; for an improvement upon the musical instrument commonly called the clarinet; which invention is also, as to part thereof, applicable to an improvement upon most of such other musical wind-instruments as are played upon with keys. Dated March 19, 1800.

William Johnson, of Widmore-House, in the parish of Bromley, in the county of Kent, Esquire; for a machine with new means of obtaining power in mechanical operations, of the nature of a self-moving power or perpetual motion. Dated March 19, 1800.

David

DAVID HARDIE, of St. James's-ſtreet, in the pariſh of St James, in the county of Middleſex; for an apparatus for weighing, in a manner leſs liable to error, and with greater expedition, than by any of the modes of weighing hitherto uſed. Dated March 19, 1800.

JOHN GLOVER, of Great Lever, in the county of Somerſet, Manufacturer; for a method of bleaching linen-cloth, and other cloths. Dated March 24, 1800.

JOHN HORATIO SAVIGNY, of King-ſtreet, in the pariſh of St. Paul, Covent Garden, Surgeon's Inſtrument-maker; for an inſtrument called a tourniquet, for more effectually hindering and ſtopping the effuſion of blood in gun-ſhot and other bad wounds, &c. Dated March 31, 1800.

CHARLES RANDOM BERENGER, of Old Bond-ſtreet, Print-ſeller; for a method of printing and colouring tranſparencies on ſilk, cotton, linen, and other wove manufactures, for carriage and window blinds, ſcreens, &c. Dated March 31, 1800.

BENJAMIN BLACKMORE, of Wandſworth, in the county of Surrey, Bolting-cloth-manufacturer; for an elaſtic ſpring, for the improvement and more complete manufacturing and forming of bolting-cloths without ſeams. Dated March 31, 1800.

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